FINAL REPORT
8526-02

LOWER COLUMBIA RIVER BI-STATE PROGRAM

RECONNAISSANCE SURVEY OF THE LOWER COLUMBIA RIVER

TASK 2 SUMMARY REPORT: INVENTORY AND CHARACTERIZATION OF POLLUTANTS

JUNE 26, 1992

Prepared By:
TETRA TECH
In Association With:
DAVID EVANS & ASSOCIATES

TETRA TECH

TC 8526-02
FINAL REPORT

RECONNAISSANCE SURVEY OF THE LOWER COLUMBIA RIVER:

TASK 2 SUMMARY REPORT: INVENTORY AND CHARACTERIZATION OF POLLUTANTS

JUNE 26, 1992

Prepared for.
THE LOWER COLUMBIA RIVER BI-STATE PROGRAM

Prepared by:
TETRA TECH INC
11820 NORTHUP WAY, SUITE 100E
BELLEVUE, WA 98005

In Association With
DAIVD EVANS AND ASSOCIATES

CONTENTS

FIGURES

TABLES

ACKNOWLEDGMENTS

This document was prepared by Tetra Tech, Inc Dr. Ted Turk of Tetra Tech served as the Project Manager for all work conducted on the lower Columbia River project. Dr. Steven Ellis of Tetra Tech served as the Task Manager for all work conducted as part of Task 2 Inventory and Characterization of Pollutants

Several individuals contributed to sections included in this document Mr Curtis DeGasperi of Tetra Tech was the principal author of sections discussing point source and tributary pollutant loading Mr Glen St Amant was the principal author of sections discussing nonpoint and in-place pollutants

Analysis and interpretation of data, identification of data gaps, and recommendations were provided by Dr. Ellis, Mr. DeGasperi, and Mr. St. Amant. Illustrations were provided by Ms. Kim Shaty Word processing was performed by Ms. Lisa Fosse.

1.0 INTRODUCTION

1.1 THE BI-STATE PROGRAM

The Lower Columbia River Bi-State Program (Bi-State Program) was initiated in 1990 in response to growing concerns about the status and ecological health of the river and its associated habitats. The four-year Bi-State Program is a cooperative effort of the Oregon Department of Environmental Quality, Washington Department of Ecology, Northwest Pulp and Paper Association, and Washington and Oregon ports. Its purpose is to evaluate water quality within the lower Columbia River, which is defined as the 146-mile stretch of river from the Bonneville Dam to the Pacific Ocean (Figure 1).

The Bi-State Program has developed the following general goals to meet their objectives

- Identify water quality problems.
- Determine if beneficial/characteristic uses are impaired.
- Develop solutions to the water quality problems.
- Make recommendations on a long-term framework for the Bi-State Program

To fulfill these goals, the Bi-State Committee developed a series of general tasks, including the following

- Evaluation of existing data on river quality.
- Design and implementation of a reconnaissance survey, baseline survey, and additional advanced field studies.
- Development of recommendations to regulatory agencies based upon identified environmental problems

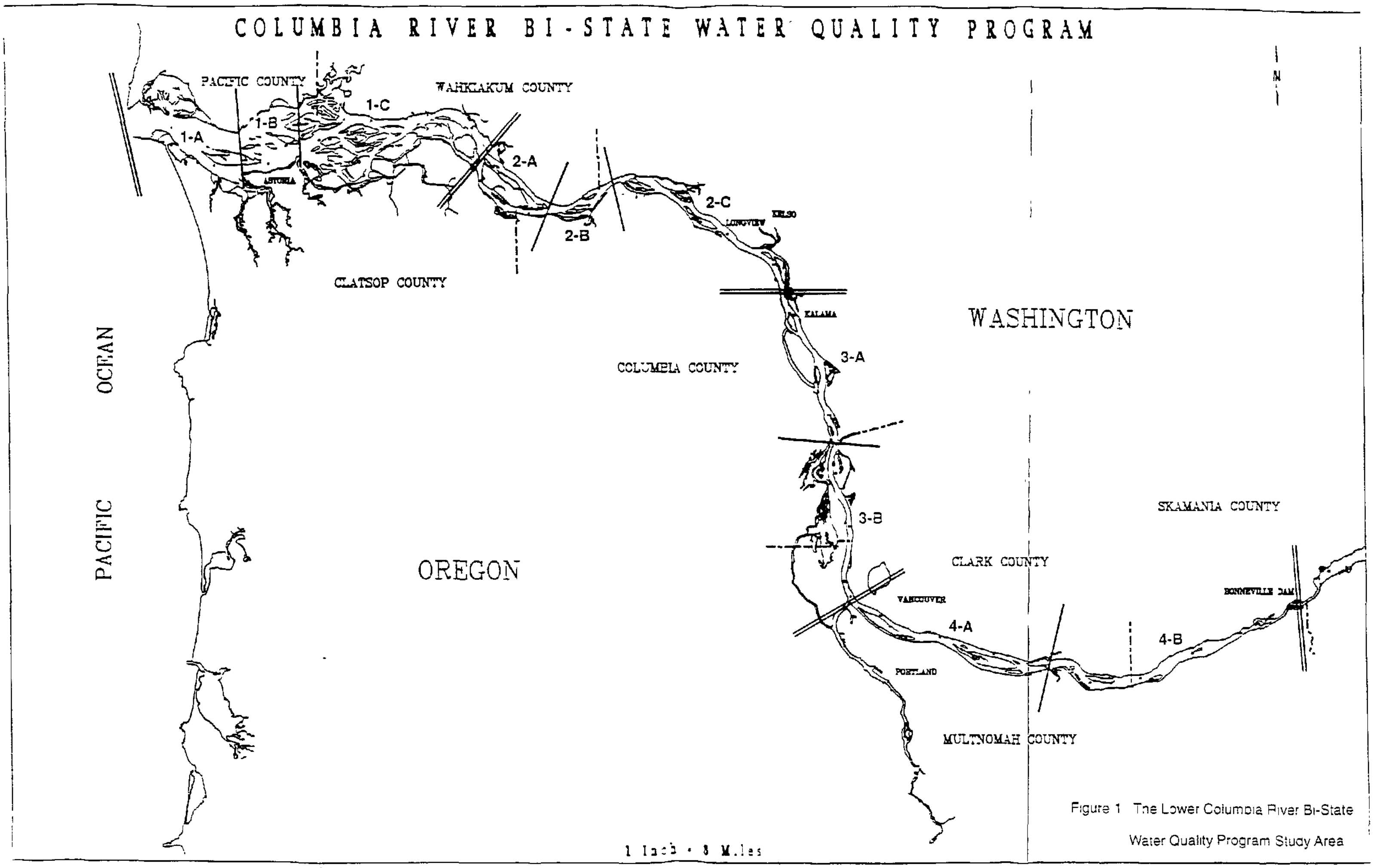


Figure 1 The Lower Columbia River Bi-State Water Quality Program Study Area

Two objectives were specified for the first year of the Bi-State Program. First, existing information was to be reviewed and synthesized to develop a basis for evaluating future studies of water quality in the lower Columbia River and to document work which has been conducted in the river basin Second, results from these findings were to be utilized to develop and implement an initial field survey (reconnaissance survey) of the river to evaluate methods for characterizing water quality and to identify potential areas or media (i e. water, sediment, aquatic organisms) that may be impaired due to poor water quality Information gathered from this first year's efforts was to provide the foundation for directing research efforts in the remaining years

1.2 OBJECTIVES OF TASK 2

The design, implementation, and evaluation of the lower Columbia River reconnaissance survey was divided into seven separate studies, or tasks, as follows:

- Task 1: Existing Data Review
- Task 2: Pollution Source Inventory and Characterization
- Task 3: Hydrologic and Physical Characterization
- Task 4: Biological Characterization
- Task 5: Beneficial Uses Characterization
- Task 6. Reconnaissance Survey
- Task 7 Technical Framework and Recommendations.

To accomplish these tasks, the river was broken down into several major and minor segments (Table 1, Figure 1) to facilitate the evaluation of data from different areas of the river Major river segments represent areas with similar physical features and confluences of major tributaries Subsegments were generally based on major geographic features along the river and confluences with smaller tributaries.

This report summarizes the work conducted as part of Task 2, and provides an inventory and characterization of existing point, non-point, and in-place pollutant sources on the lower Columbia River. *Point sources* of pollution are defined as discrete sources that discharge directly to the waters of the lower Columbia River Usually these sources discharge to the river via pipes or outfalls *Non-point sources* of pollution represents those contaminants that enter the river from dispersed land or water-based activities. Non-point source pollution is usually difficult to quantify, because the mechanisms of pollutant transport (e g., surface runoff, groundwater transport, atmospheric deposition) are difficult to characterize and the

TABLE I LOWER COLUMBIA RIVER SEGMENTATION DEFINITIONS					
Segment		Description	River Start	Mile End	Total Mileage
1	A	Mouth of the Columbia to Youngs Bay	0	13	37
	B	Youngs Bay to Tongue Point	13	18 5	
	C	Tongue Point to Tenasillahe Island	18 5	38	
2	A	Tenasillahee Island to Cathlamet Channel	38	47	31
	B	Cathlamet Channel to River Mile 54	47	53 5	
	C	River Mile 54 to Cowlitz River	53 5	72	
3	A	Cowlitz River to Lewis River	72	87 5	34
	B	Lewis River to Willamette River	87 5	102	
4	A	Willamette River to Sandy River	102	125 3	44
	B	Sandy River to Bonneville Dam	123 5	146	

loading rates can vary considerably both temporally and spatially For the purpose of this report, *in-place pollutants* are defined as contaminants associated with hazardous waste sites, landfills, or septic tank leaks near the river

Task 2 specifically addressed the following four objectives

- To organize and summarize available data and estimates on pollutant loading (i e , the amount of pollutants entering the river over a specified period of time) to the lower Columbia River from point sources, major tributaries, and in-place pollutant sources

- To inventory sites and activities that may contribute to non-point source pollution loading in the lower Columbia River.

- To identify data gaps that hinder estimates of pollutant loading.

- To provide information useful in the formulation of the reconnaissance survey sampling plan

Completion of these objectives required breaking Task 2 into several preliminary reports First, a list of information sources that were to be used was developed This list was compiled and submitted to the Bi-State Committee and contained descriptions of the information sources that were expected to be used for the data analysis and pollution loading calculations. Second, a large, detailed data analysis report was prepared This report, *Task 2 Data Analysis Report Inventory and Characterization of Pollutants;* contained a discussion of point sources, land use, tributary pollutant loading, non-point sources, and in-place pollutant data. Available information on each individual point source, major tributary, and in-place pollutant source was summarized Pollution loading estimates were calculated for point sources regulated by Oregon and Washington's National Pollution Discharge Elimination System (NPDES) permits and for major tributaries where data on pollutant concentrations and river flow data were available Finally, this *Task 2 Summary Report* provides a summary and synthesis of all work conducted as part of Task 2 It summarizes the information presented in the data analysis report and discusses whether sections of the river are potentially impaired by pollutants

2.0 SUMMARY OF POLLUTANT SOURCES EVALUATED

This section briefly summarizes and synthesizes conclusions, existing information gaps, and recommendations based on research presented in the data report, *Reconnaissance Survey of the Lower Columbia River—Task 2 Data Analysis Report Inventory and Characterization of Pollutants* Additional technical summaries, pollutant source information, and methods for calculating pollutant loading are all described in the data analysis report

Potential pollutant sources were organized into three general categories based on their origins

- Point sources of pollution.
- Non-point sources of pollution.
- In-place sources of pollution

Each of these pollutant categories is discussed in subsequent sections.

2.1 POINT SOURCES OF POLLUTION

Fifty-four point sources of pollution discharge directly to the lower Columbia River (Figure 2) All of these sources represent domestic, industrial, or agricultural facilities that discharge wastewater directly to the river through a pipe or channel and are regulated by permits under the U.S. Environmental Protection Agency's (U S. EPA) National Pollution Discharge Elimination System (NPDES). The U.S. EPA has delegated NPDES permitting authority to the Oregon Department of Environmental Quality (ODEQ) and the Washington Department of Ecology (WDOE); therefore, the individual states are directly responsible for screening and regulating discharges from these facilities. Individual permits specify limitations on the types and amounts of chemicals that can be discharged to the river, and stipulate specific monitoring requirements to insure that these limits are not exceeded. Monitoring data from 1989 and 1990 were collected from ODEQ and WDOE permit files to evaluate pollutant loading to the river.

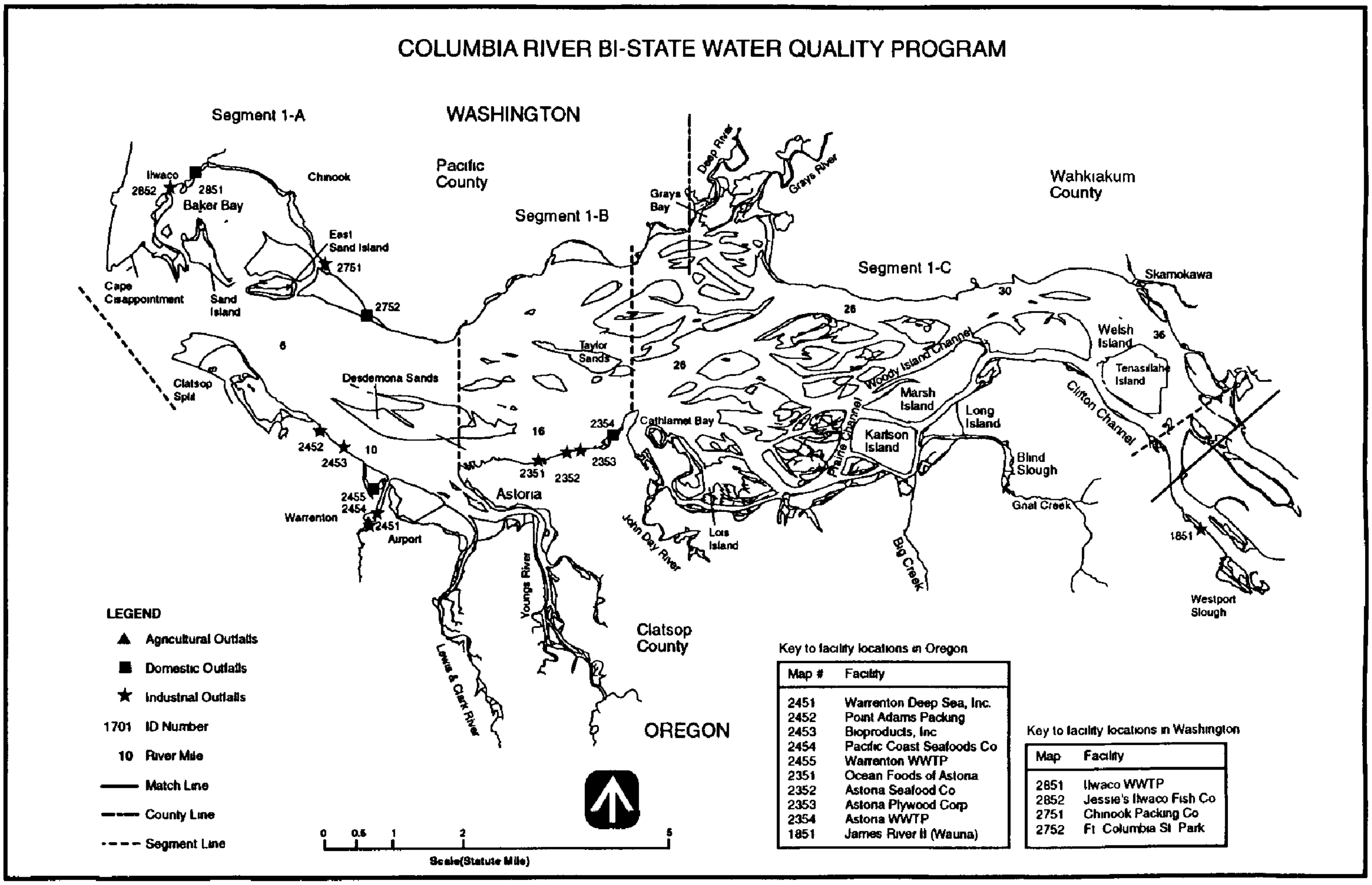
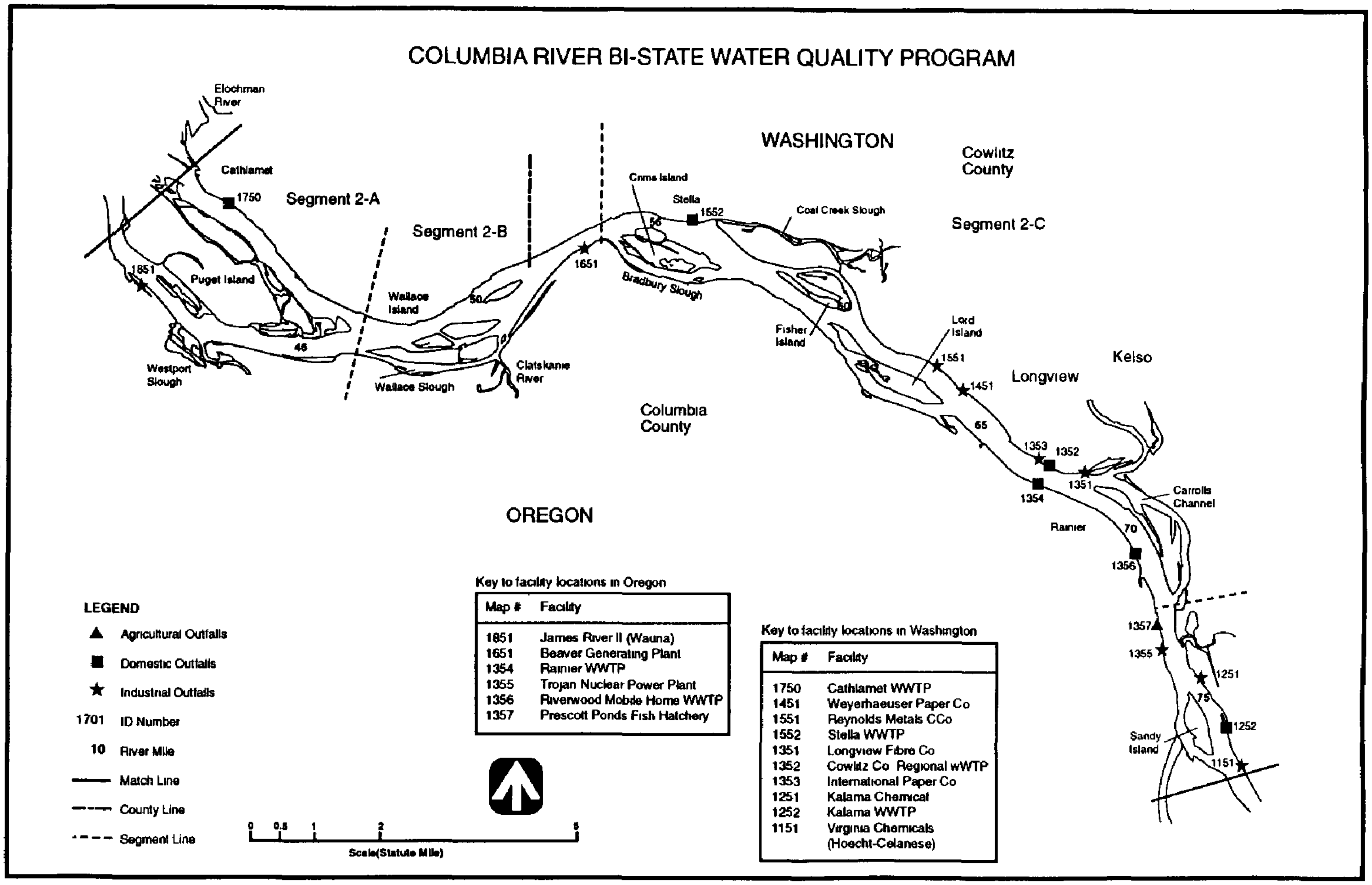


Figure 2a. Locations of NPDES-Permitted Point Source Dischargers in the Lower Columbia River



Key to facility locations in Oregon

Map #	Facility
1851	James River II (Wauna)
1651	Beaver Generating Plant
1354	Rainier WWTP
1355	Trojan Nuclear Power Plant
1356	Riverwood Mobile Home WWTP
1357	Prescott Ponds Fish Hatchery

Key to facility locations in Washington

Map #	Facility
1750	Cathlamet WWTP
1451	Weyerhaeuser Paper Co
1551	Reynolds Metals CCo
1552	Stella WWTP
1351	Longview Fibre Co
1352	Cowlitz Co Regional wWTP
1353	International Paper Co
1251	Kalama Chemical
1252	Kalama WWTP
1151	Virginia Chemicals (Hoecht-Celanese)

Figure 2b Locations of NPDES-Permitted Point Source Dischargers in the Lower Columbia River

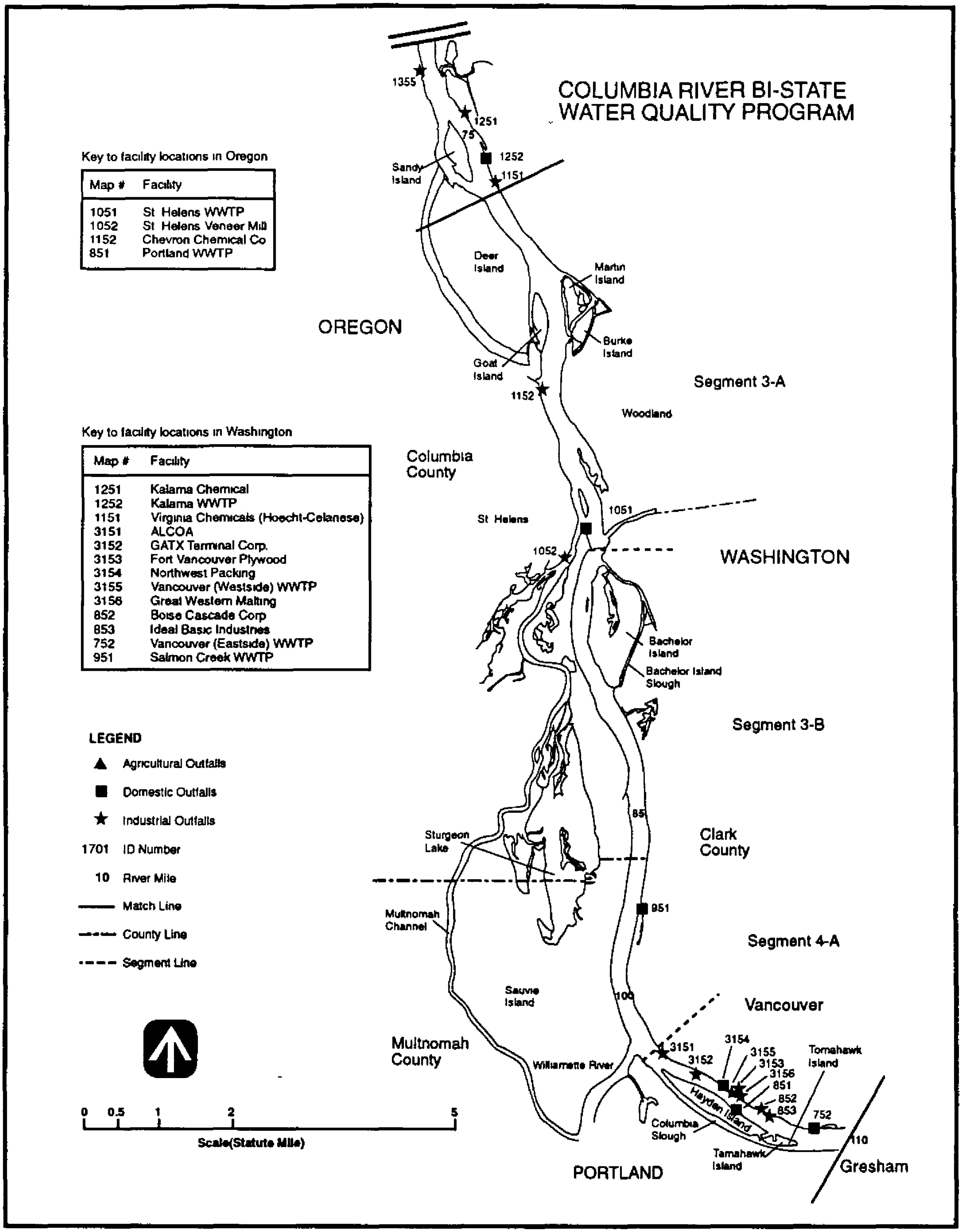
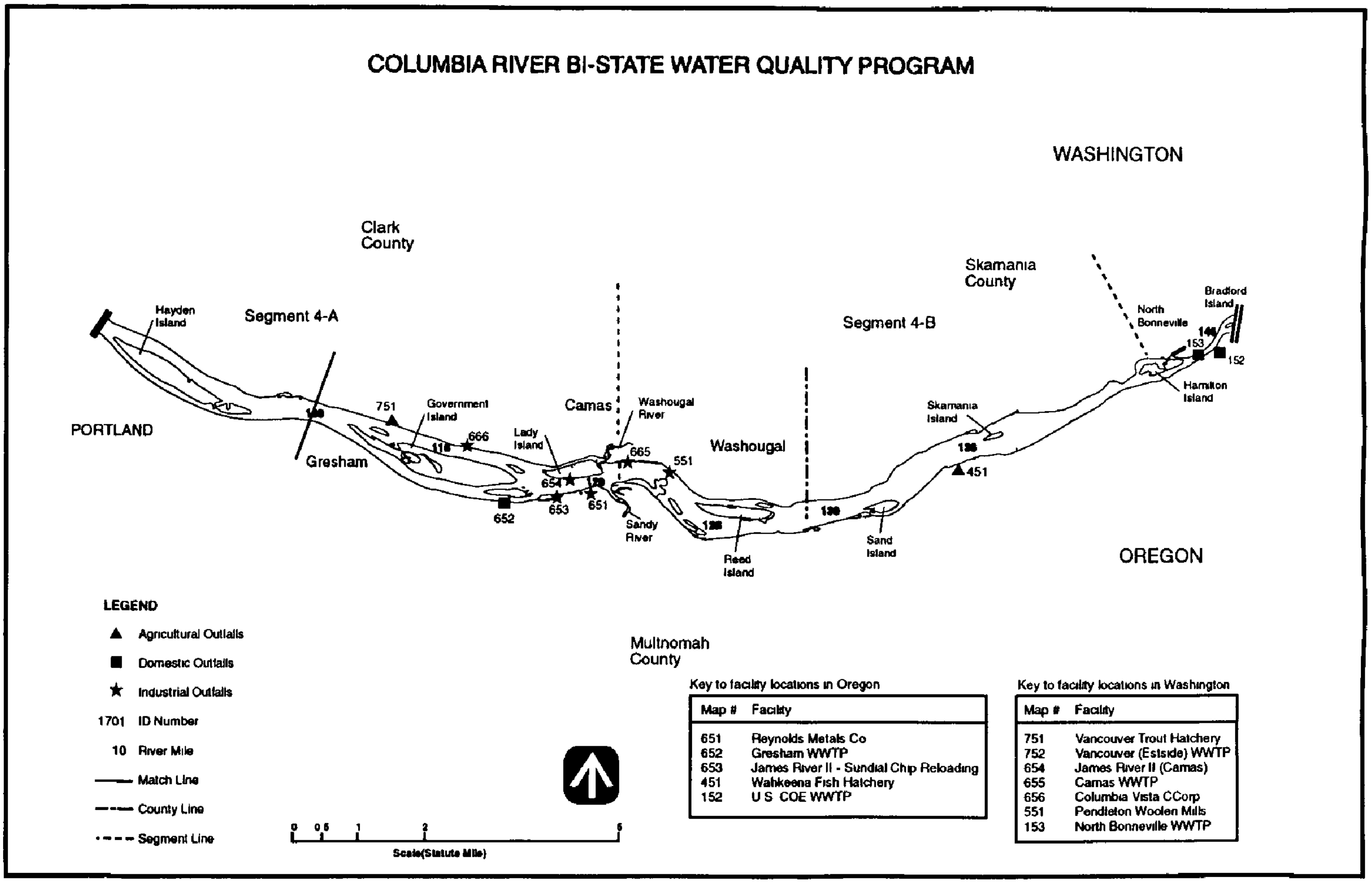


Figure 2c. Locations of NPDES-Permitted Point Source Dischargers in the Lower Columbia River



Key to facility locations in Oregon

Map #	Facility
651	Reynolds Metals Co
652	Gresham WWTP
653	James River II - Sundial Chip Reloading
451	Wahkeena Fish Hatchery
152	U S COE WWTP

Key to facility locations in Washington

Map #	Facility
751	Vancouver Trout Hatchery
752	Vancouver (Estside) WWTP
654	James River II (Camas)
655	Camas WWTP
656	Columbia Vista CCorp
551	Pendleton Woolen Mills
153	North Bonneville WWTP

Figure 2d Locations of NPDES-Permitted Point Sources in the Lower Columbia River

2.2 NON-POINT SOURCES OF POLLUTION

Non-point source pollution was characterized by evaluating the following indicators

- Land use in bordering counties.
- Pollutant loading data for tributaries.
- Urban stormwater and combined sewer overflow (CSO) information
- Atmospheric deposition data
- Data on accidental chemical spills.

Land use information was compiled from literature reviews and interviews with key agency personnel. Stormwater and CSO information were collected by telephone interviews with municipalities and port facilities along the lower Columbia River. Estimates for pollutant loading from tributaries were compiled from flow and water quality data from the U S. EPA STORET database, the U S. Geological Survey (USGS) National Stream Quality Accounting Network (NASQUAN), and a variety of USGS reports documenting flow information Atmospheric deposition data was collected from WDOE's Environmental Investigations and Laboratory Services Program. Information on accidental chemical spills to the Columbia River and its tributaries from 1989 to 1991 was compiled from the U S. Coast Guard National Response Center Database.

2.3 IN-PLACE SOURCES OF POLLUTION

Eighteen landfills and seventeen hazardous waste sites along the lower Columbia River (Figure 3) were evaluated for contaminants of concern, media contaminated (groundwater, soil, surface water), and the potential for pollution transport to the river. Data and files were collected from the U.S. EPA Region X Superfund Office, WDOE, ODEQ, the Cowlitz County Health District, and the Southwest Region County Health District in the summer of 1991 Therefore, results of this study do not reflect any changes in site classifications or chemicals of concern that may have occurred after that time. For example, it is possible that a hazardous waste site has been cleaned up, new sites have been listed, or landfills have opened or closed. To determine if sites are currently classified as presented, the appropriate regulating authority should be contacted.

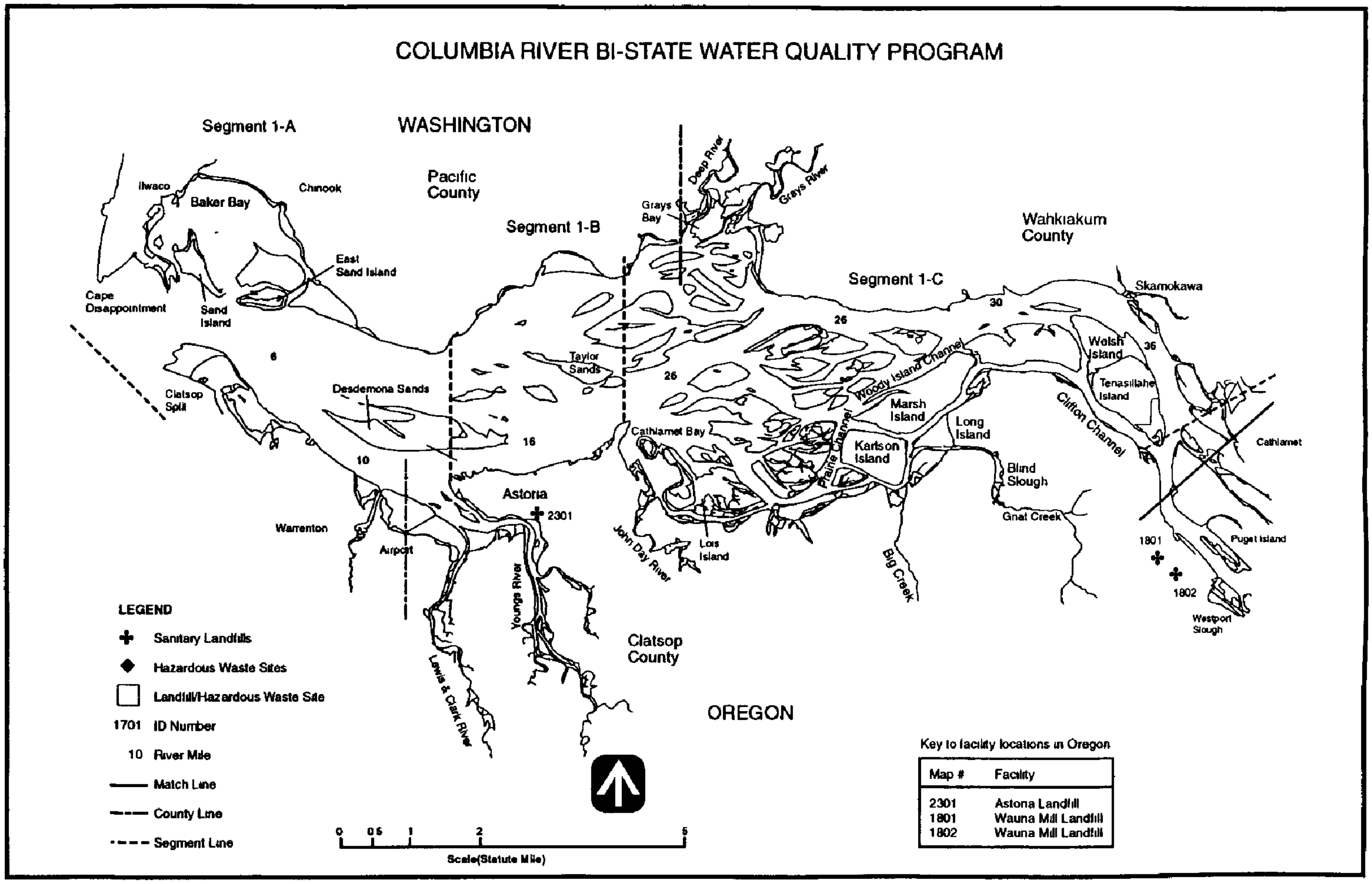


Figure 3a Locations of Landfills and Hazardous Waste Sites Adjacent to the Lower Columbia River

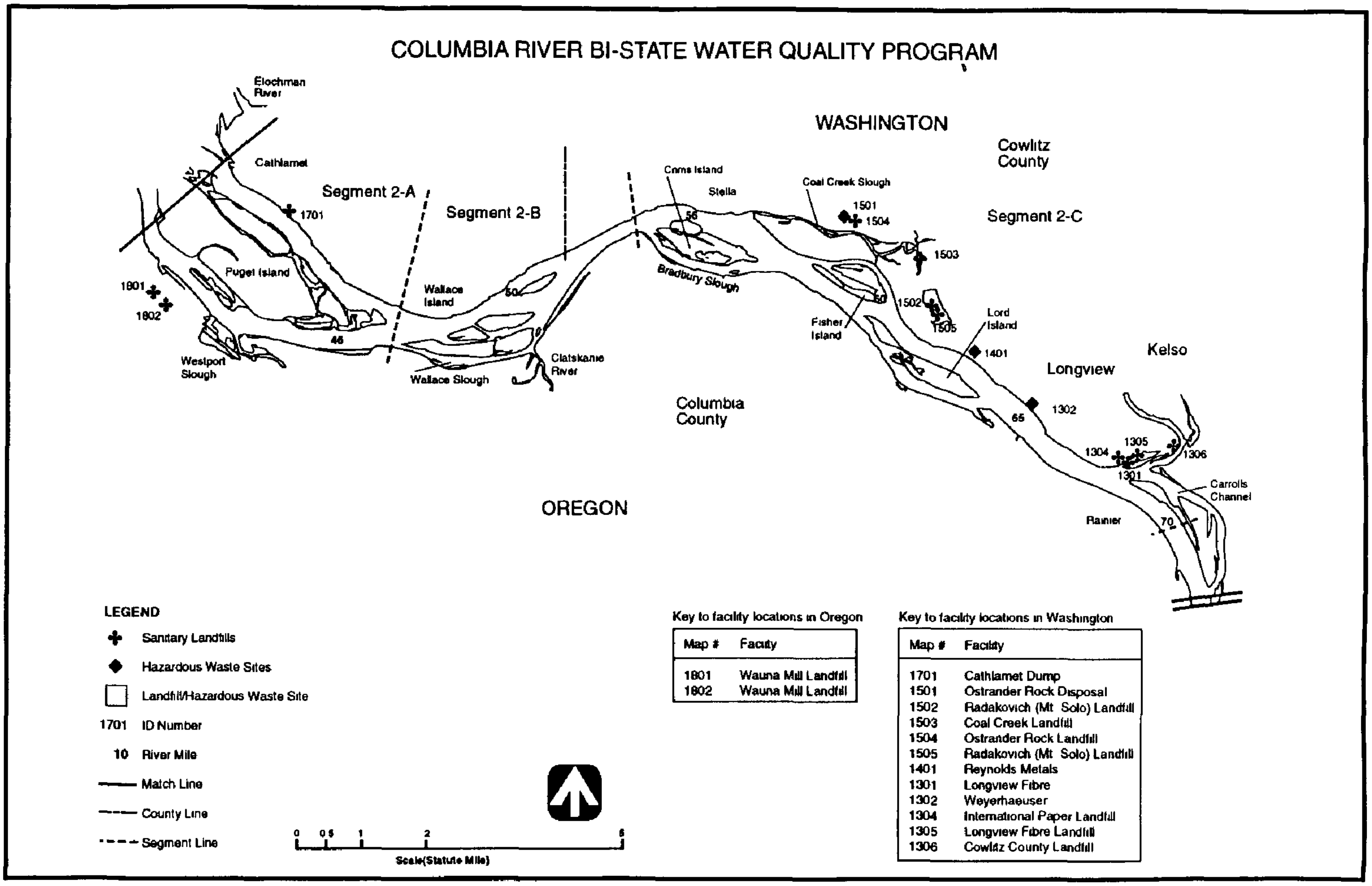


Figure 3b Locations of Landfills and Hazardous Waste Sites Adjacent to the Lower Columbia River

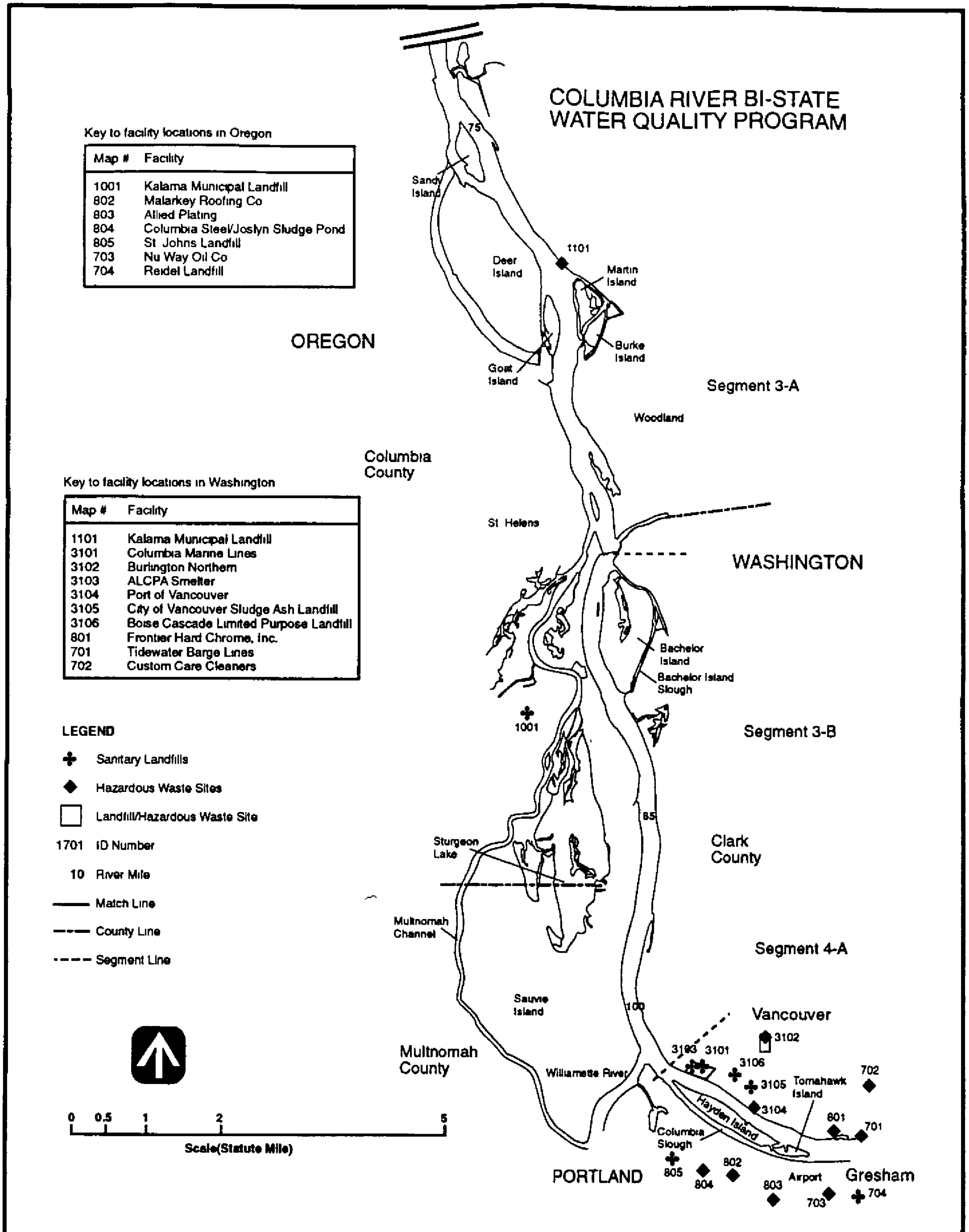
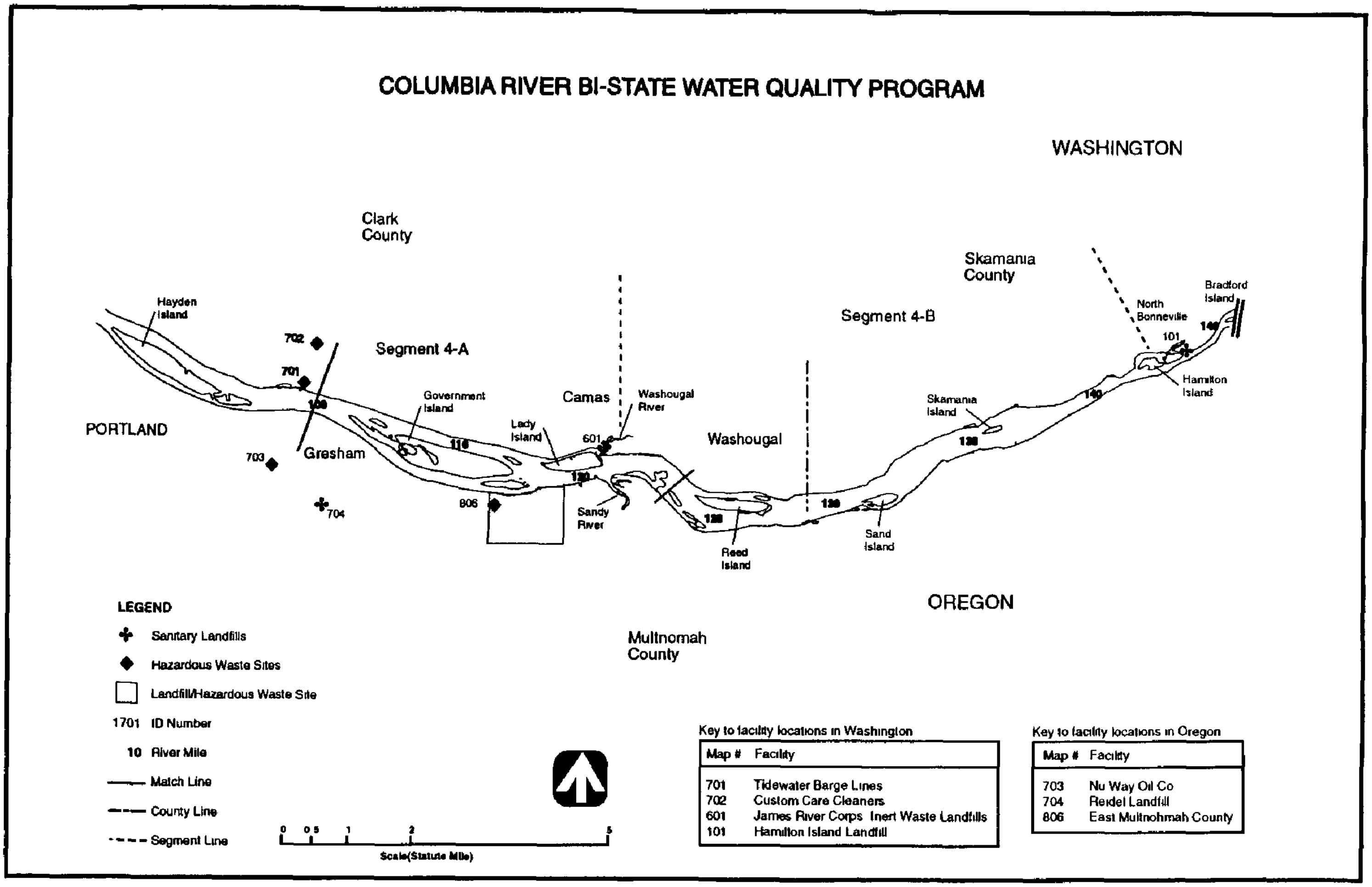


Figure 3c. Locations of Landfills and Hazardous Waste Sites Adjacent to the Lower Columbia River



Key to facility locations in Washington

Map #	Facility
701	Tidewater Barge Lines
702	Custom Care Cleaners
601	James River Corps Inert Waste Landfills
101	Hamilton Island Landfill

Key to facility locations in Oregon

Map #	Facility
703	Nu Way Oil Co
704	Reidel Landfill
806	East Multnohmah County

Figure 3d. Locations of Landfills and Hazardous Waste Sites Adjacent to the Lower Columbia River

Several indicators of potential sources of in-place pollutants were evaluated. These included potential hazardous waste sites listed on either U.S. EPA RCRA Notifiers List and CERCLIS Lists in counties adjacent to the lower Columbia River, were examined for areas with the greatest potential for other sources of in-place hazardous waste contamination. In addition, Oregon and Washington county health districts were contacted for information regarding septic system construction and repairs in counties adjacent to the lower Columbia River.

3.0 EVALUATION OF POLLUTANT SOURCES

This section discusses the relative significance of the three categories of pollutant sources (point, non-point, and in-place) to the pollution load entering the lower Columbia River Whenever possible, quantitative estimates of the amount of pollutants entering the river (i e , loading rates) were calculated to aid in comparison of sources.

Estimates of pollutant loading to the lower Columbia River could only be made for certain pollutants for the following sources· NPDES-permitted point sources, major tributaries, and the upper Columbia River. For point sources, data were most complete for wastewater discharge volume, biological oxygen demand (BOD), and total suspended solids (TSS) For tributary loading (a non-point source), data were most complete for discharge volume, TSS, metals, and other inorganic constituents including nutrients. These data allow only limited comparisons to be made between point sources and tributary loading data For other pollutant sources such as non-point surface runoff, groundwater input, atmospheric deposition, urban stormwater, combined sewer overflow discharges, septic tank discharges, landfills, and hazardous waste sites, insufficient information was available to estimate the quantities of pollutants entering the river.

Pollutant loading is a function of the discharge rate and pollutant concentration. Usually calculation of pollutant loading is quite straightforward; however, when the pollutant concentration is less than the detection limit of the analytical procedure employed, estimation of loading rates is uncertain because the unknown concentration may fall somewhere between that detection limit and zero A conservative approach to estimating pollutant loading was used for estimating pollutant loading of constituents reported as not detected. This approach assumed that the concentration of a chemical reported as not detected had a concentration equal to the laboratory detection limit. This approach likely overestimates loading rates of constituents reported as not detected. Based on the limited data available it was not possible determine the extent of overestimation of any pollutant constituent.

3.1 POINT SOURCES OF POLLUTION

Of the fifty-four NPDES-permitted point sources that discharge directly to the lower Columbia River, 8 were major domestic (or municipal) wastewater treatment plants (WWTPs), 11 were minor domestic WWTPs, 3 were major aluminum industries, 5 were pulp and paper industries, 6 were wood products industries, 4 were major and minor chemical industries, 2 were power generation facilities, 8 were seafood processing facilities, 4 were miscellaneous industries, and 3 were agricultural (fish hatchery) facilities. These facilities have varying limitations for the type and amounts of pollutants discharged. This is reflected in the varying NPDES monitoring requirements for these facility types (Table 2). Most of the facilities monitor a variety of conventional variables such as temperature, pH, biochemical oxygen demand (BOD), total suspended solids (TSS), oil and grease, fecal coliform bacteria, and residual chlorine (Table 2). Other parameters including nutrients, metals, and organic compounds are measured by fewer dischargers

3.1.1 Wastewater

The total discharge of wastewater from NPDES-permitted facilities in the lower Columbia River averaged 475 MGD for the years 1989 and 1990 Wastewater discharge from the pulp and paper industry accounts for about half (52 percent) of this total (Figure 4), with wastewater discharge from major municipal sources accounting for the next largest fraction (32 percent). Together the six pulp and paper mills along the lower Columbia River and the municipal wastewater treatment facilities in the cities of Astoria, St. Helens, Portland, and Gresham, Oregon, and Longview and Vancouver, Washington account for 84 percent of the wastewater discharged from permitted point sources directly to the lower Columbia River The next largest source is major chemical industry discharges, which account for less than 8 percent of the total wastewater discharge.

To put the discharge from NPDES point sources into perspective, the rate of wastewater discharge from these sources can be compared with the discharge from tributaries entering the lower Columbia River, and the discharge of the upper Columbia River to the lower Columbia River measured at Warrendale, OR below Bonneville Dam (Figure 4). The annual average NPDES-permitted point source wastewater discharge (475 MGD) is roughly equivalent to 75 percent of the annual average discharge from the Kalama River (653 MGD) - the fifth largest tributary to the lower Columbia River Annual average NPDES-permitted point source wastewater discharge (500 MGD) is less than 1.7 percent of the discharge from the five largest lower Columbia tributaries (30,000 MGD) and 0.4 percent of the upper Columbia River discharge (120,000 MGD).

TABLE 2 SUMMARY OF PERMITTED-POINT SOURCE POLLUTANT MONITORING REQUIREMENTS FOR FACILITIES DISCHARGING DIRECTLY TO THE LOWER COLUMBIA RIVER BELOW BONNEVILLE DAM
(Page 1 of 9)

	Municipal		Industrial										Agricultural
	Wastewater Facilities		Aluminum	Pulp and Paper	Wood Products	Chemical		Power Generation		Seafood Processing	Miscellaneous Industry		Fish Hatcheries
Monitoring Parameter	Major	Minor	Major	Major	Minor	Major	Minor	Major	Minor	Minor	Major	Minor	Minor
CONVENTIONALS													
Temperature	X	X	X	X	X	X	X	X	X	X	X	X	X
pH	X	X	X	X	X	X	X	X	X	X	X	X	X
Dissolved Oxygen	X	X											
BOD	X	X	X	X	X	X		X		X	X		X
TSS	X	X	X	X		X		X		X	X		X
COD											X		
Fecal Coliform Bacteria	X	X	X	X	X			X		X			X
Oil and Grease			X	X		X		X	X	X	X		X
Color	X												
Residual Chlorine	X	X	X	X	X			X	X				
NITROGEN AND PHOSPHORUS COMPOUNDS													
Total Phosphorus	X					X				X			X
Ammonia-N	X					X				X			X
Nitrate-N	X				X								
Total Kjeldahl Nitrogen	X					X							
METALS													
Aluminum			X					X					
Antimony			X										
Arsenic	X					X							

TABLE 2 SUMMARY OF PERMITTED-POINT SOURCE POLLUTANT MONITORING REQUIREMENTS FOR FACILITIES DISCHARGING DIRECTLY TO THE LOWER COLUMBIA RIVER BELOW BONNEVILLE DAM
(Page 2 of 9)

	Municipal		Industrial										Agricultural
	Wastewater Facilities		Aluminum	Pulp and Paper	Wood Products	Chemical		Power Generation		Seafood Processing	Miscellaneous Industry		Fish Hatcheries
Monitoring Parameter	Major	Minor	Major	Major	Minor	Major	Minor	Major	Minor	Minor	Major	Minor	Minor
Barium	X												
Beryllium											X		
Cadmium	X		X		X	X					X		
Chromium	X		X		X	X					X		
Cobalt						X							
Copper	X		X	X	X	X		X	X		X		
Iron	X							X	X				
Lead	X		X	X		X					X		
Magnesium						X							
Manganese	X												
Mercury	X										X		
Nickel	X		X	X		X					X		
Selenium											X		
Silver	X										X		
Sodium								X					
Thallium											X		
Tin						X							
Zinc	X		X		X	X	X				X		
ADDITIONAL INORGANIC PARAMETERS													
Cyanide	X		X			X					X		
Sulfide											X		

TABLE 2 SUMMARY OF PERMITTED-POINT SOURCE POLLUTANT MONITORING REQUIREMENTS FOR FACILITIES DISCHARGING DIRECTLY TO THE LOWER COLUMBIA RIVER BELOW BONNEVILLE DAM

(Page 3 of 9)

	Municipal		Industrial										Agricultural
	Wastewater Facilities		Aluminum	Pulp and Paper	Wood Products	Chemical		Power Generation		Seafood Processing	Miscellaneous Industry		Fish Hatcheries
Monitoring Parameter	Major	Minor	Major	Major	Minor	Major	Minor	Major	Minor	Minor	Major	Minor	Minor
Sulfate								X					
Boron	X							X					
Fluoride	X		X										
RADIOISOTOPES													
Thorium 232	X												
Asbestos											X		
ORGANIC COMPOUNDS													
Volatiles													
Acrolein	X					X					X		
Acrylonitrile	X					X					X		
Benzene	X					X					X		
Bromoform	X										X		
Carbon tetrachloride	X					X					X		
Chlorobenzene	X					X					X		
Chlorodibromomethane	X					X					X		
Chloroethane	X					X					X		
2-Chloroethylvinyl ether	X										X		
Chloroform	X					X					X		
Dichlorobromomethane	X										X		

TABLE 2 SUMMARY OF PERMITTED-POINT SOURCE POLLUTANT MONITORING REQUIREMENTS FOR FACILITIES DISCHARGING DIRECTLY TO THE LOWER COLUMBIA RIVER BELOW BONNEVILLE DAM
(Page 4 of 9)

	Municipal		Industrial										Agricultural
	Wastewater Facilities		Aluminum	Pulp and Paper	Wood Products	Chemical		Power Generation		Seafood Processing	Miscellaneous Industry		Fish Hatcheries
Monitoring Parameter	Major	Minor	Major	Major	Minor	Major	Minor	Major	Minor	Minor	Major	Minor	Minor
1,1-dichloroethane	X					X					X		
1,2-dichlorethane	X					X					X		
1,1-dichloroethylene	X					X					X		
1,2-dichloropropane	X					X					X		
1,3-dichloropropylene	X					X					X		
Ethylbenzene	X					X					X		
Methylbromide	X										X		
Methylchloride	X					X					X		
Methylenechloride	X					X					X		
1,1,2,2-tetrachloroethane	X										X		
Tetrachloroethylene	X					X					X		
Toluene	X					X					X		
1,2-trans-dichloroethylene	X					X					X		
1,1,1-trichloroethane	X					X					X		
1,1,2-trichloroethane	X					X					X		
Trichloroethylene	X					X					X		
Vinylchloride	X					X					X		
Semivolatile Compounds													
Acid Extractable													
2-chlorophenol	X					X					X		
2,4-dichlorophenol	X					X					X		

TABLE 2 SUMMARY OF PERMITTED-POINT SOURCE POLLUTANT MONITORING REQUIREMENTS FOR FACILITIES DISCHARGING DIRECTLY TO THE LOWER COLUMBIA RIVER BELOW BONNEVILLE DAM

(Page 5 of 9)

	Municipal		Industrial										Agricultural
	Wastewater Facilities		Aluminum	Pulp and Paper	Wood Products	Chemical		Power Generation		Seafood Processing	Miscellaneous Industry		Fish Hatcheries
Monitoring Parameter	Major	Minor	Major	Major	Minor	Major	Minor	Major	Minor	Minor	Major	Minor	Minor
4,6-dinitro-o-cresol	X					X					X		
2,4-dinitrophenol	X					X					X		
2-nitrophenol	X					X					X		
4-nitrophenol	X					X					X		
p-chloro-m-cresol	X										X		
Pentachlorophenol	X				X						X		
Phenol	X				X	X					X		
2,4,6-trichlorophenol	X					X					X		
Base/Neutral Extractable - Halogenated Ethers													
bis(2-chloroethyl)ether	X										X		
bis(2-chloroethoxy)methane	X										X		
bis(2-chloroisopropyl)ether	X										X		
4-bromophenyl phenyl ether	X										X		
4-chlorophenyl phenyl ether	X										X		
Base/Neutral Extractable - Nitroaromatics													
2,4-dinitrotoluene	X					X					X		
2,6-dinitrotoluene	X					X					X		
Nitrobenzene	X					X					X		

TABLE 2 SUMMARY OF PERMITTED-POINT SOURCE POLLUTANT MONITORING REQUIREMENTS FOR FACILITIES DISCHARGING DIRECTLY TO THE LOWER COLUMBIA RIVER BELOW BONNEVILLE DAM

(Page 6 of 9)

	Municipal		Industrial										Agricultural
	Wastewater Facilities		Aluminum	Pulp and Paper	Wood Products	Chemical		Power Generation		Seafood Processing	Miscellaneous Industry		Fish Hatcheries
Monitoring Parameter	Major	Minor	Major	Major	Minor	Major	Minor	Major	Minor	Minor	Major	Minor	Minor
Base/Neutral Extractable - Nitrosamines													
N-nitroso-di-n-propylamine	X										X		
N-nitrosodimethylamine	X										X		
N-nitrosodiphenylamine	X										X		
Base/Neutral Extractable - Chlorinated Naphthalenes													
2-chloronaphthalene	X										X		
Base/Neutral Extractable - Polynuclear Aromatics													
Acenaphthene	X				X	X					X		
Acenaphthylene	X				X	X					X		
Anthracene	X				X	X					X		
Benzo(a)anthracene	X				X	X					X		
Benzo(k)fluoranthene	X				X	X					X		
3,4-benzofluoranthene	X				X	X					X		
Benzo(a)pyrene	X		X		X	X					X		
Benzo(g,h,i)perylene	X				X						X		
Chrysene	X				X	X					X		
Dibenzo(a,h)anthracene	X				X						X		
Fluoranthene	X				X	X					X		
Fluorene	X				X	X					X		
Ideno(1,2,3-cd)pyrene	X				X						X		

TABLE 2 SUMMARY OF PERMITTED-POINT SOURCE POLLUTANT MONITORING REQUIREMENTS FOR FACILITIES DISCHARGING DIRECTLY TO THE LOWER COLUMBIA RIVER BELOW BONNEVILLE DAM
(Page 7 of 9)

	Municipal		Industrial										Agricultural
	Wastewater Facilities		Aluminum	Pulp and Paper	Wood Products	Chemical		Power Generation		Seafood Processing	Miscellaneous Industry		Fish Hatcheries
Monitoring Parameter	Major	Minor	Major	Major	Minor	Major	Minor	Major	Minor	Minor	Major	Minor	Minor
Naphthalene	X				X	X					X		
Phenanthrene	X				X	X					X		
Pyrene	X				X	X					X		
Base/Neutral Extractable - Chlorinated Benzenes													
1,3-dichlorobenzene	X					X					X		
1,2-dichlorobenzene	X					X					X		
1,4-dichlorobenzene	X					X					X		
1 2 4-trichlorobenzene	X					X					X		
Hexachlorobenzene	X					X					X		
Base/Neutral Extractable - Hexachlorinated Compounds													
Hexachlorobutadiene	X					X					X		
Hexachloroethane	X					X					X		
Hexachlorocyclopentadiene	X										X		
Base/Neutral Extractable - Benzidines													
3,3 -dichlorobenzidine	X										X		
Benzidine	X										X		

TABLE 2 SUMMARY OF PERMITTED-POINT SOURCE POLLUTANT MONITORING REQUIREMENTS FOR FACILITIES DISCHARGING DIRECTLY TO THE LOWER COLUMBIA RIVER BELOW BONNEVILLE DAM
(Page 8 of 9)

	Municipal		Industrial										Agricultural
	Wastewater Facilities		Aluminum	Pulp and Paper	Wood Products	Chemical		Power Generation		Seafood Processing	Miscellaneous Industry		Fish Hatcheries
Monitoring Parameter	Major	Minor	Major	Major	Minor	Major	Minor	Major	Minor	Minor	Major	Minor	Minor
Base/Neutral Extractable - Phthalate Esters													
Bis(2-ethylhexyl)phthalate	X					X					X		
Butylbenzyl phthalate	X										X		
Di-n-butyl phthalate	X					X					X		
Di-n-octyl phthalate	X										X		
Diethyl phthalate	X					X					X		
Dimethyl phthalate	X					X					X		
Base/Neutral Extractable - Miscellaneous													
1,2-diphenylhydrazine	X										X		
Isophorone	X										X		
PESTICIDES AND METABOLITES													
4,4'-DDT	X										X		
4,4'-DDE	X										X		
4,4'-DDD	X										X		
Heptachlor	X										X		
Heptachlor epoxide	X										X		
Chlordane	X										X		
Aldrin	X										X		
Dieldrin	X										X		
Alpha-BHC	X										X		
Beta-BHC	X										X		

TABLE 2 SUMMARY OF PERMITTED-POINT SOURCE POLLUTANT MONITORING REQUIREMENTS FOR FACILITIES DISCHARGING DIRECTLY TO THE LOWER COLUMBIA RIVER BELOW BONNEVILLE DAM
(Page 9 of 9)

	Municipal		Industrial										Agricultural
	Wastewater Facilities		Aluminum	Pulp and Paper	Wood Products	Chemical		Power Generation		Seafood Processing	Miscellaneous Industry		Fish Hatcheries
Monitoring Parameter	Major	Minor	Major	Major	Minor	Major	Minor	Major	Minor	Minor	Major	Minor	Minor
Gamma-BHC (Lindane)	X										X		
Delta-BHC	X										X		
Alpha-endosulfan	X										X		
Beta-endosulfan	X										X		
Endosulfan sulfate	X										X		
Endrin	X										X		
Endrin aldehyde	X										X		
Toxaphene	X										X		
ALACHLORS (PCBs)													
PCB-1242	X										X		
PCB-1254	X										X		
PCB-1221	X										X		
PCB-1232	X										X		
PCB-1248	X										X		
PCB-1260	X										X		
PCB-1016	X										X		
DIOXINS/FURANS/ADSORBABLE ORGANIC HALOGENS (AOX)													
TCDDs	X			X							X		
TCDFs	X			X									
AOX	X			X									

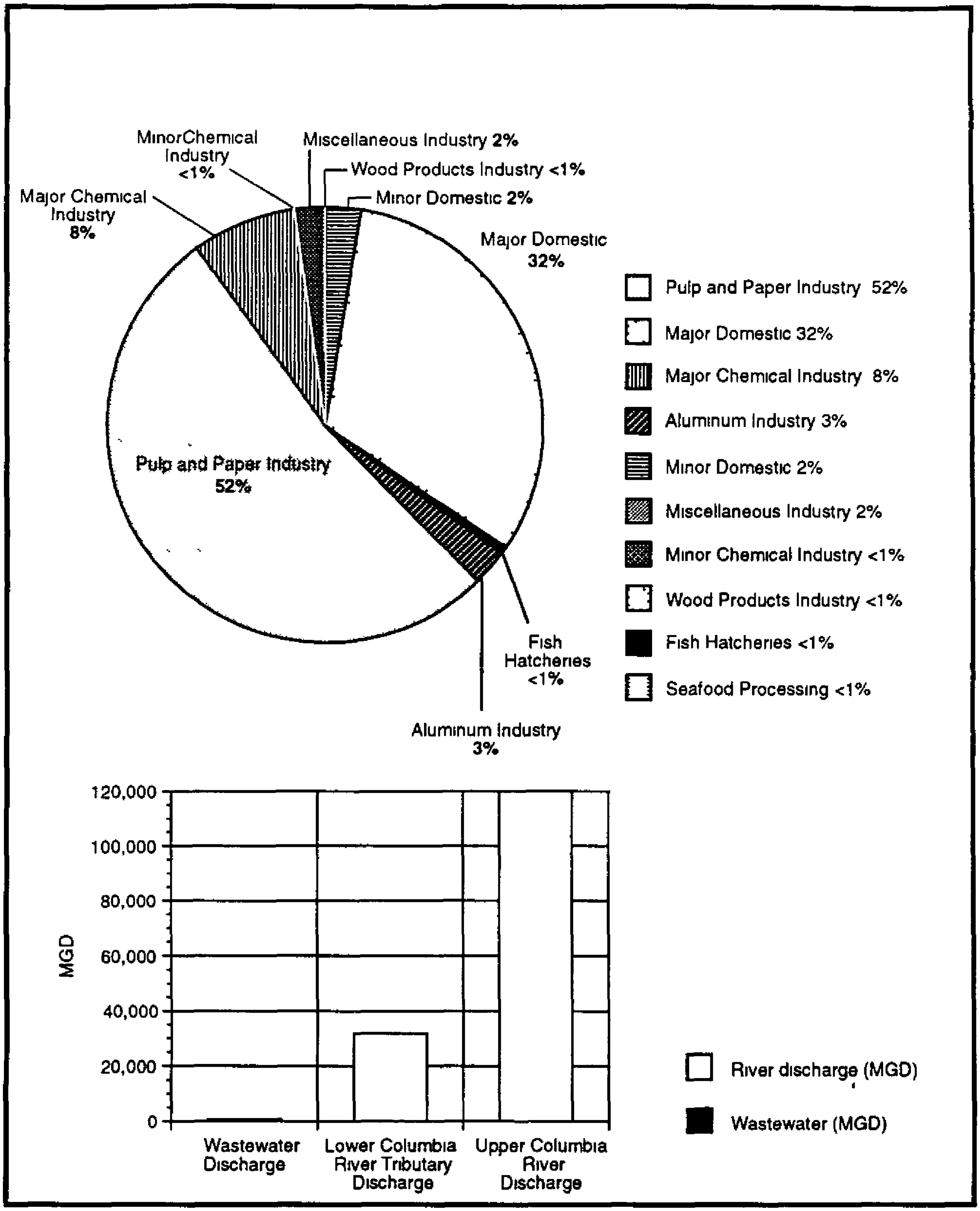


Figure 4. Annual Point Source Discharge to the Lower Columbia River

3.1.2 Total Suspended Solids

Total suspended solids (TSS) are a defined water quality parameter that refers to the five particulates that remain suspended in the water sample being analyzed The total discharge of total suspended solids (TSS) from NPDES-permitted facilities that discharge wastewater directly to the lower Columbia River averaged 140,000 lb/day for the years 1989 and 1990 Wastewater discharge from the pulp and paper industry accounts for about three quarter (76 percent) of this total, with wastewater discharge from major municipal sources accounting for the next largest fraction (22 percent) (Figure 5). Together the six pulp and paper mills along the lower Columbia River and the municipal wastewater facilities in the cities of Astoria, St Helens, Portland, and Gresham, Oregon, and Longview and Vancouver, Washington account for 99 percent of the TSS discharged directly to the lower Columbia River.

The discharge of TSS to the lower Columbia River from point sources is only a very small fraction of that entering the river from the upper Columbia River and tributaries The discharge of TSS from point sources is approximately 3 percent of the annual average TSS discharge from the Willamette River (4,720,000 lb/day) and less than 1 percent of the TSS entering the lower river from the upper Columbia River (18,700,000 lb/day).

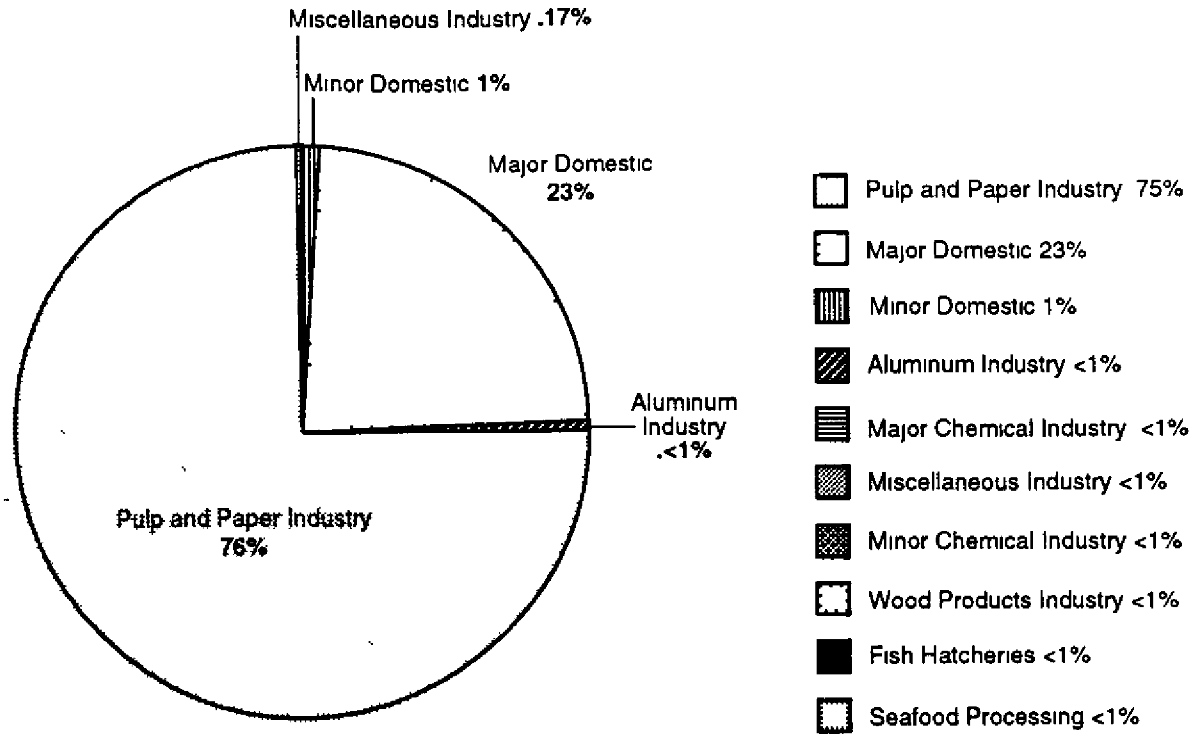
3.1.3 Biochemical Oxygen Demand

BOD is a measure of the oxygen consumed due to the organic matter that is present in the treated wastewater prior to discharge. When large quantities of BOD are discharged to the river, oxygen concentrations in the water decline. Low oxygen concentrations in the river are detrimental to fish and other animals that live in the river.

BOD loading from various direct NPDES-permitted point sources is presented in Figure 6 The pulp and paper industry discharges the largest amount (66 percent) of BOD. The second largest discharge is from major domestic facilities (32 percent). Together, these two sources account for 98 percent of the NPDES-permitted BOD loading directly to the lower Columbia River. No data on BOD for the tributaries was available and therefore, no comparison of point source BOD loading with tributaries is possible.

3.1.4 Bacteria

Fecal coliform bacteria have traditionally been used as an indication of fecal contamination of waters from poorly treated or untreated wastewater. The levels of fecal coliform bacteria in effluent discharged from domestic point sources and some industries that have sanitary treatment facilities is an indication of the effectiveness of the disinfection process—using



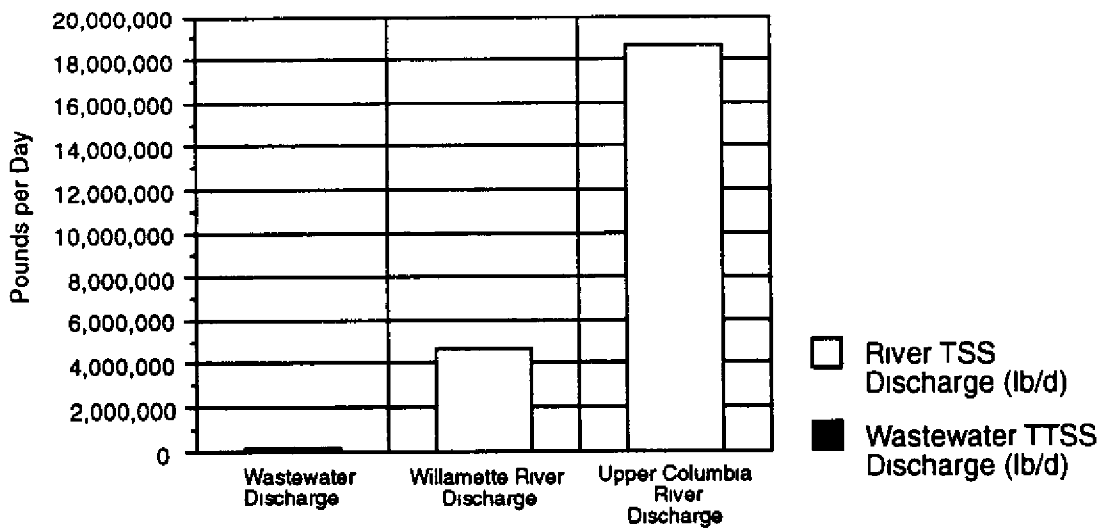


Figure 5. Relative Percent Contribution of TSS from Point Sources to the Lower Columbia River Below Bonneville Dam

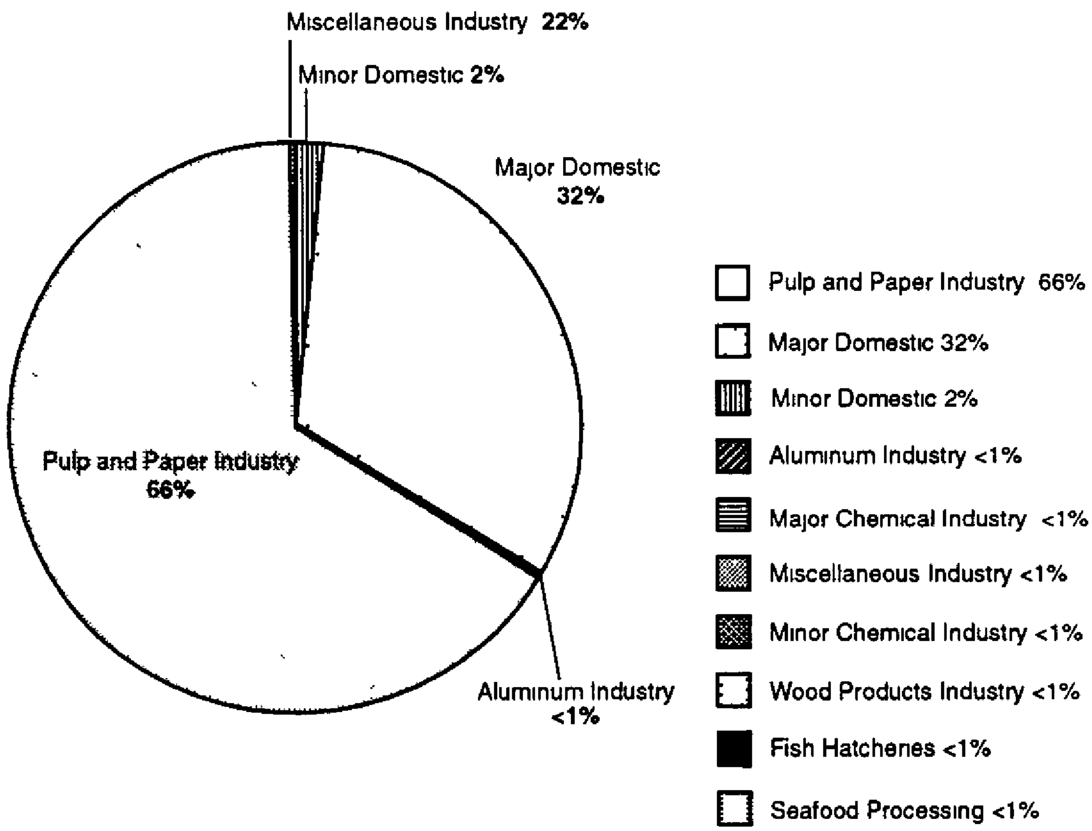


Figure 6. Relative Percent Contribution of BOD From Point Sources to the Lower Columbia River Below Bonneville Dam

chlorine—prior to discharge of the wastewater However, recent studies have questioned the supposed correlation between fecal coliform bacteria and disease-causing bacteria and viruses

The concentration of fecal coliform bacteria in effluent from NPDES-permitted point sources was evaluated in Task 2 No data were identified on direct estimation of pathogenic organisms from the various pollutant sources In general, only treated sanitary/domestic wastewater discharges are required to regularly determine the concentration of fecal coliform bacteria in effluent While occasional, elevated concentrations of fecal coliform bacteria were reported in NPDES monitoring reports, on a seasonal average these concentrations were typically within their NPDES permit limits. A few samples of the treated process wastewater from the Weyerhaeuser Paper Co. (Longview) pulp and paper mill and the final effluent from the City of St Helens WWTP (which treats the primary treated wastewater from the Boise Cascade pulp and paper mill) had elevated concentrations of fecal coliform bacteria NPDES permit effluent limits did not apply to these sources, and the significance of their presence is not presently known. The strain of bacteria detected in pulp and paper mill effluent may be *Klebsiella*, which is associated with both fecal and environmental sources Approximately 30 to 40 percent of all warm-blooded animals have *Klebsiella (K. pneumoniae)* in their intestinal tracts. Other *Klebsiella* species *(K planticola* and *K. terrigena)* have their origins in the environment, being found, among other sources, in external tree tissues (Geldreich and Rice 1987).

3 1.5 Metals and Other Mineral Elements

Although metals and other mineral elements (e.g., boron and fluoride) are normal constituents of river water, many of these elements are concentrated by human activity Therefore, treated domestic and industrial wastewaters typically contain elevated concentrations of some of these elements. Some of these elements are toxic to aquatic organisms if concentrations reach high enough levels. Some of these elements also bioaccumulate in the tissues of organisms and can interfere with the reproduction and health of organisms, or cause death.

Although data for metals and other mineral elements were limited, some comparisons between permitted point sources, the Willamette River, and loading from the upper Columbia River can be made (Figure 7). Estimated aluminum loading from the Willamette River in 1989 was 7,590 lb/day while estimated aluminum loading to river segments 2C (just downstream of Crims Is to the Cowlitz River), 3A (from the Cowlitz River to the Lewis River), and 4A (from the Willamette River to the Sandy River) from permitted point sources was estimated at 24, 73, and 47 lb/day, respectively. Estimated loading of iron from the Willamette River and upper Columbia River was 11,200 lb/day and 110,000 lb/day, respectively. Estimated iron loading to river segment 4A (from the Willamette River to the Sandy River) from permitted point sources was 155 lb/day. Although point source loading of sodium to river segment 3A

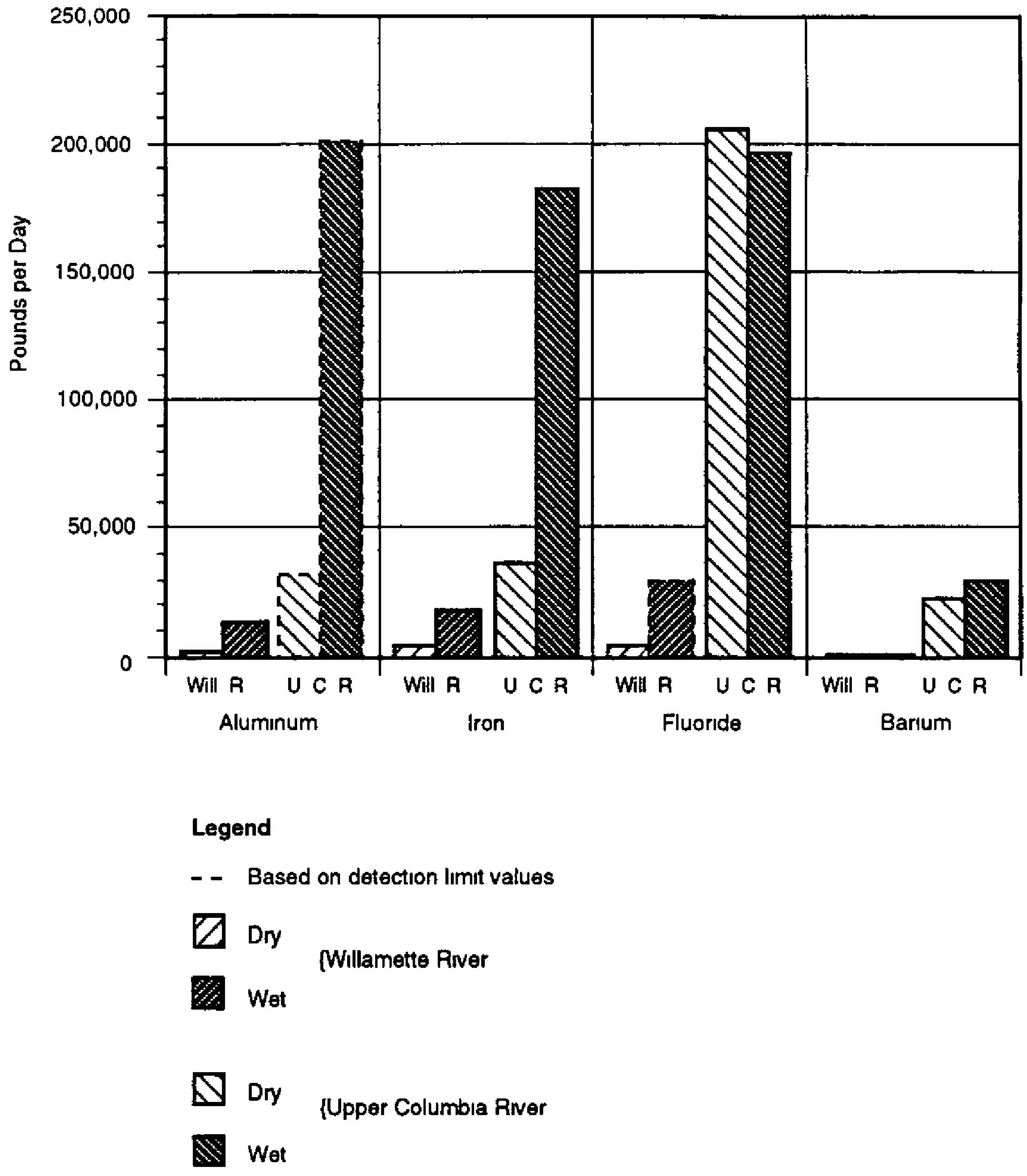


Figure 7. Comparison of Metals (Al, Fe, Ba) and Fluoride Loading from the Upper Columbia River and Willamette River

(from the Cowlitz River to the Lewis River) was estimated at 3,642 lb/day, sodium loading from the Willamette River alone was estimated at 852,000 lb/day Fluoride loading from point sources was estimated at 895 lb/day, while loading estimated for the upper Columbia River was over 200,000 lb/day

Few data are available for metals that commonly occur in trace concentrations in the natural environment because the concentration of these metals are often below the analytical detection limits used in their analysis Loading data for the common trace metals (arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, and zinc) from the upper Columbia River and Willamette River are compared in Figure 8 These metals are typically undetected, with the exception of copper, in water samples from the Willamette River and the Warrendale NASQUAN stations. Thus, the relative contribution of these metals from point sources and tributaries remains uncertain, although, it is possible that point sources are a significant source For example, the loading of zinc from the Willamette River (based on detected concentrations) was 556 lb/day, while estimated zinc loading from point sources to river segment 4A was 70 lb/day It should be noted, however, that a great deal of uncertainty surrounds estimates of metals loading from tributaries and the upper river because of the uncertain quality of the NASQUAN data (Windom et al. 1991) and the lack of data on bedload transport of contaminants. Non-point sources such as urban runoff, atmospheric deposition, and in-place pollutants may also be a significant source, but at present no loading data are available for comparison.

3.1.6 Nutrients

Nutrients are essential for the growth of algae (phytoplankton) that float in the river and algae that grow attached to the bottom (periphyton) Nutrients essential for algae growth include the elements nitrogen and phosphorus These elements are available for algal growth as water soluble compounds of nitrogen (nitrate and ammonia) and soluble compounds of phosphorus (phosphates) When nutrient concentrations are high and other conditions such as light are favorable, algae concentrations may reach levels that are a nuisance to recreation and other beneficial uses of the river.

Estimates of direct point source loading of nutrients was generally inadequate for determining the relative importance of the various sources to nutrient loading to the lower Columbia River This is due to the lack of nutrient loading information from major domestic point sources and pulp and paper industry facilities, non-point sources, and in-place pollutants. Estimated loading of total phosphorus, ammonia nitrogen, and nitrate-nitrite nitrogen from the Willamette River was 14,500, 51,800, and 118,000 lb/day, respectively (Figure 9). Nutrient loading from point sources could only be calculated for two chemical facilities as these facilities were the

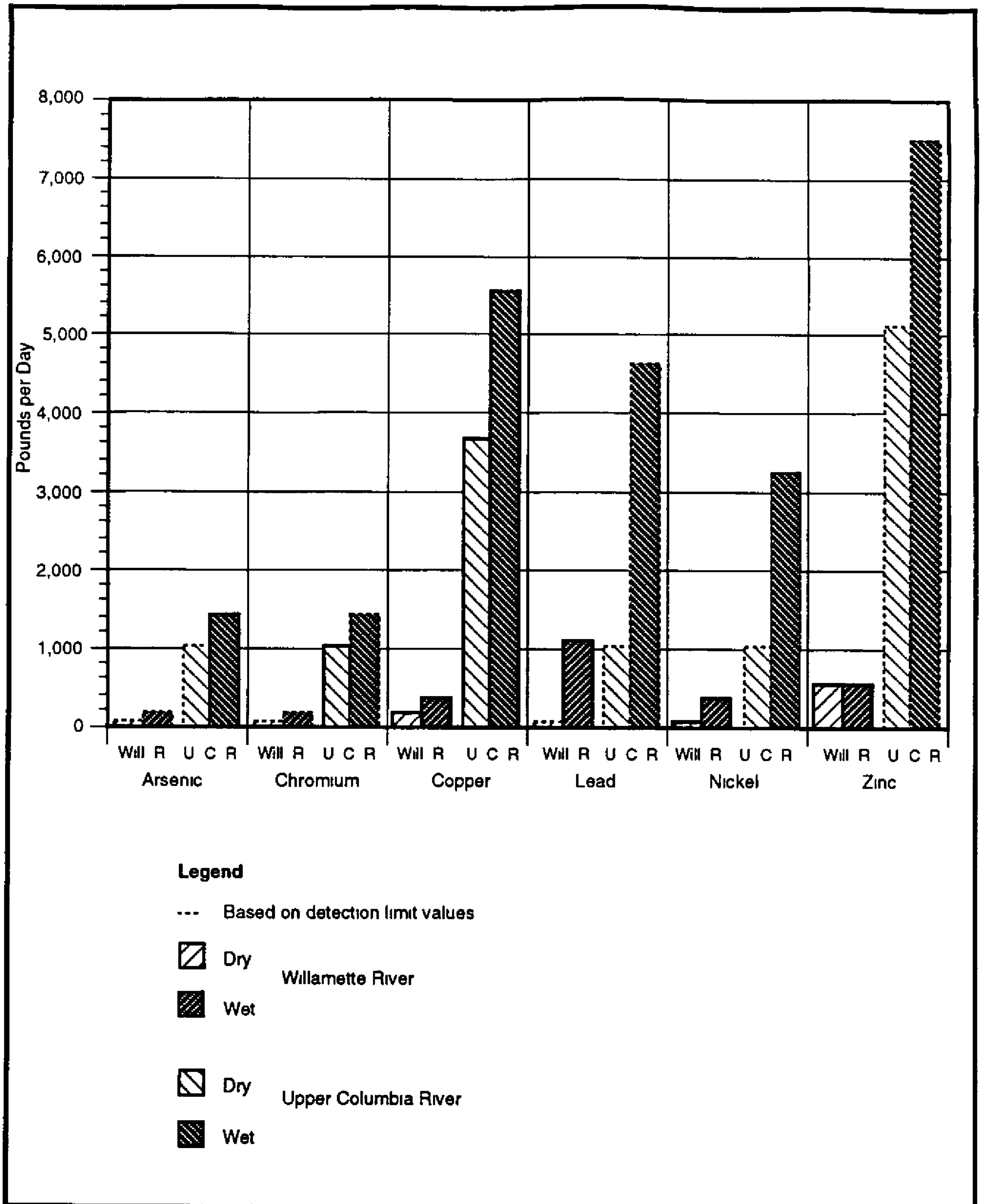


Figure 8 Comparison of Metals (As, Cr, Cu, Pb, Ni, Zn) Loading from the Upper Columbia River and Willamette River

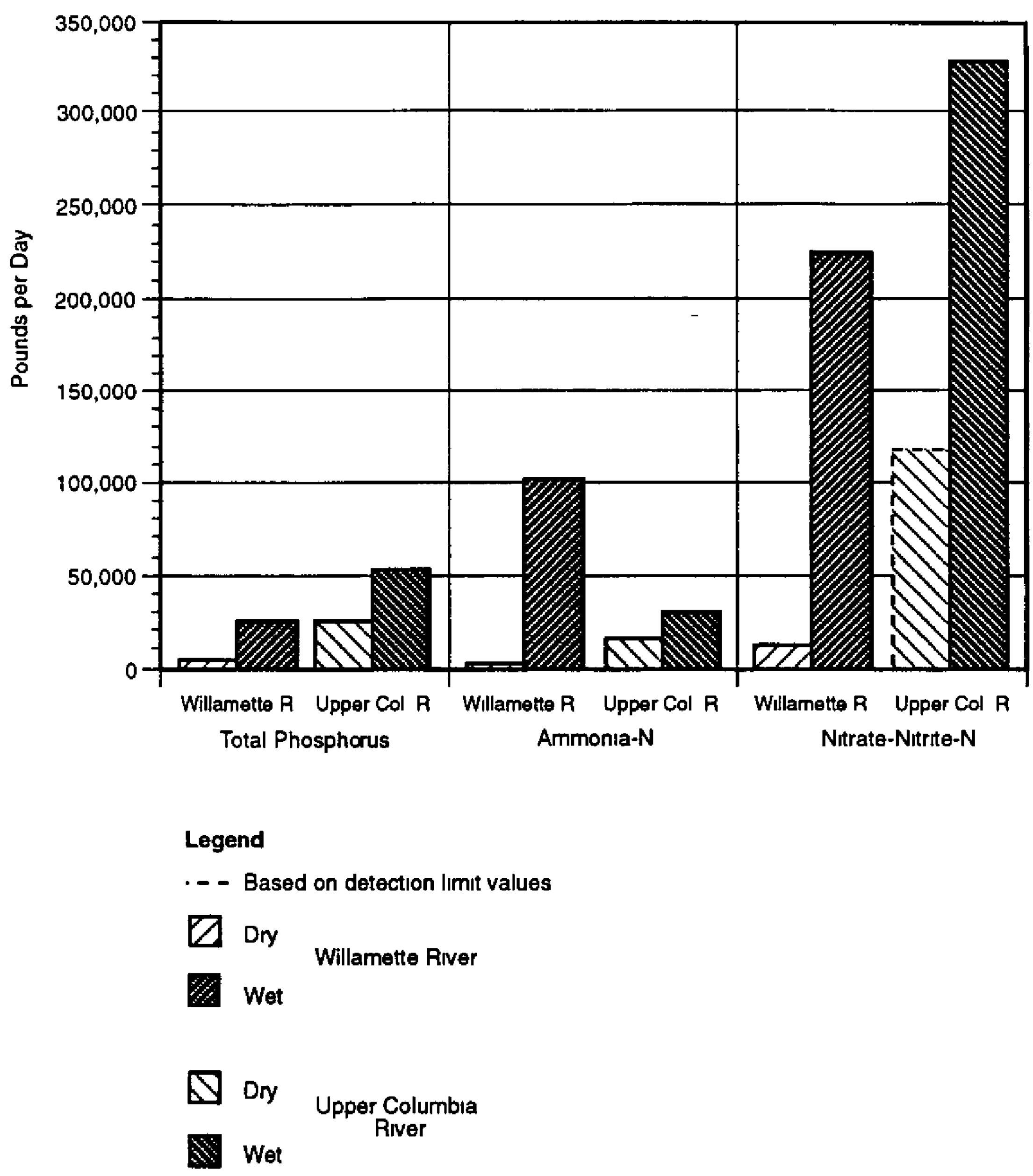


Figure 9. Comparison of Nutrient Loading from the Upper Columbia River and Willamette River

sources required to measure nutrients in their effluent. Ammonia nitrogen loading was estimated at 57 lb/day and total phosphorus loading was estimated at 2 6 lb/day Although nutrient loading from the Willamette River and the upper Columbia River is large, data are needed on the likely significant point source discharges of nutrients (e g , municipal and pulp and paper mill discharges), stormwater runoff directly to the river, and septic tank nutrient contributions to adequately determine the relative significance of these sources

3.1.7 Organic Pollutants

Organic pollutants (i e , compounds containing carbon and hydrogen) are generated by human activity and many are highly toxic to organisms in the river, even at very low levels. Many organic compounds containing chlorine atoms are highly toxic and are readily concentrated in fatty tissues of organisms. Some of these organic pollutants are also concentrated in the tissues of organisms that live in or near the river and can interfere with the reproduction and health of the organisms, or cause death.

Even less data are available for the evaluation of the relative importance of organic pollutant loading to the lower Columbia River No data are available from the major tributaries, and organic pollutant loading estimates from point sources are incomplete. Although limited data are available on petroleum spills to the river and its tributaries, the information suggests that a few large accidents account for most of the quantities reported. Organic pollutants of anthropogenic origins (e.g , pesticides, U.S. EPA priority organic pollutants, and petroleum products) likely pose serious environmental concerns However, lack of data on these pollutant sources prevents determining their relative importance.

3.2 EVALUATION OF NON-POINT SOURCES OF POLLUTION

3.2.1 Land Use

Land use is a valuable indicator of non-point source pollution because the types of pollutants and their potential for entering water bodies can be correlated with land use activities. Land use was divided into the following four general categories: forest, agriculture, urban, and other A summary of land use, by these categories, in counties adjacent to the lower Columbia River is presented in Table 3. The predominant land use classification in counties adjacent to the study area is forest (81 8%), which includes public lands, national forests, and private lands managed for timber production Agricultural uses are the next most predominant, but comprise only 7 7 percent of the total acreage surveyed. Issues of potential concern to water quality related to forest practices include increased erosion of soils, accumulation and decomposition of excess log debris in water, elevated stream temperatures from decreased vegetative

TABLE 3 LAND USE SUMMARY (Estimated Acreage)					
	Forest	Agriculture	Urban	Other	Total
Oregon					
Clatsop	454,803	25,821	14,719	19,857	515,200
Columbia	288,000	73,949	23,000	54,731	439,680
Multnomah	142,498	35,011	74,016	19,195	270,720
Washington					
Clark	226 969	94,646	43,699	36,030	401,344
Cowlitz	583,024	37,612	36,816	74,644	732,096
Pacific	530,000	34,870	720	15,510	581,100
Skamania	1,044,016	6,726	2,235	17,295	1,070,272
Wahkiakum	146,346	14,616	1,280	4,606	166,848
TOTAL	3,415,656	323,251	196,485	241,868	4,177,260
	81 8%	7 7%	4 7%	5 8%	100%

cover, and runoff of nutrients and/or pollutants applied as fertilizers, herbicides, and/or pesticides Information documenting chemicals applied to Oregon and Washington forest lands is presented in the Task 2 Data Analysis Report (Tetra Tech 1992). Concerns relating to water quality impacts of agricultural practices include application and runoff of nutrient-rich fertilizers, pesticides, herbicides, and enhanced erosion of soils.

3.2.2 Urban Stormwater and Combined Sewer Overflow Runoff

Urban stormwater runoff is generally routed to discrete pipes, which in turn directly discharge to the Columbia River Combined sewer overflows (CSOs) can discharge mixed stormwater runoff with untreated municipal sewage. Both of these nonpoint discharges carry a potentially large array of dissolved or particulate pollutants (e.g., oil and grease from street runoff) After contacting municipalities and port districts, it was determined that programs monitoring these non-point sources are currently being initiated. Therefore, although no quantitative or qualitative estimate of stormwater runoff or CSO effects could be made, data to calculate loading rates will become available shortly after monitoring programs begin collecting data

3.2.3 Tributary Pollutant Loading

Tributaries to the lower Columbia River discharge their respective point and non-point source pollution to the lower river From the standpoint of impacts to the lower Columbia River, the upper river can be considered a tributary which carries water from a very large watershed. The relative contribution of point and non-point source pollution to these tributaries could not be determined However, based upon existing monitoring and flow data, some loading estimates of metals, nutrients, and pollutants could be compared for tributaries and point sources. Comparison of tributary loading rates to point source dischargers were presented in Section 3 1 of this report

Based upon loading estimates (Table 4), the tributaries that contribute the greatest load of nutrients and other pollutants to the lower Columbia River are the Sandy River [discharging to river segment 4A (the Portland/Vancouver area)], the Willamette River [discharging to river segment 3B (the Multnomah Channel to the Willamette River)], the Lewis River [discharging to river segment 3A (the Lewis River to the Multnomah Channel)], and the Cowlitz River [discharging to river segment 2C (the Longview area). The upper Columbia River also represents a significant source of nutrients, some metals, and other miscellaneous constituents Although the upper Columbia River represents a potentially large source of nutrient and pollutant loading to the lower river due to its very large flow, data suggests the Willamette River may also be a significant source of some metals, nutrients, and total suspended solids.

TABLE 4 TRIBUTARY LOADING ESTIMATES					
River	BOD[a] (lb/d)	Total P (lb/d)	$NO_2 + NO_3$ N (lb/d)	$NH_3 + NH_4$ N (lb/d)	TOC[b] (lb/d)
Sandy River					
Dry season[c]	NA	117	235	176	1,761
Wet season[d]	NA	1,921	3,666	524	17,459
Washougal River					
Dry season	NA	NA	NA	NA	NA
Wet season	289	NA	NA	NA	NA
Willamette River					
Dry season	NA	6,312	17,787	5,164	91,805
Wet season	NA	25,301	157,427	22,490	562,241
E Fork Lewis River					
Dry season	NA	10	202	10	NA
Wet season	NA	90	4,138	90	NA
Kalama River					
Dry season	NA	224	134	45	NA
Wet season	NA	173	3,636	87	NA
Cowlitz River					
Dry season	NA	449	2,074	346	NA
Wet season	NA	3,272	17,669	1,963	NA

[a] Biochemical oxygen demand

[b] Total organic carbon

[c] April through September

[d] October through March

NA = No data available

Source Based on flow and water quality data in Task 2 Analysis Report

Because the upper Columbia River and tributaries to the lower Columbia River contain pollutants from point, non-point, and in-place sources, these rivers integrate the pollutant loading from sources within their watersheds. Tributaries that drain extensive areas of developed agricultural, forest, and urban lands (e g., the Willamette River) are likely significant sources of pollutants to the lower Columbia River Non-point and in-place pollutants within these large drainage basins may be more relevant sources of pollutant loading to the lower Columbia River, especially persistent toxic pollutants, than, non-point and in-place pollutant loading from nearshore areas along the river

3.2 4 Atmospheric Pollutant Loading

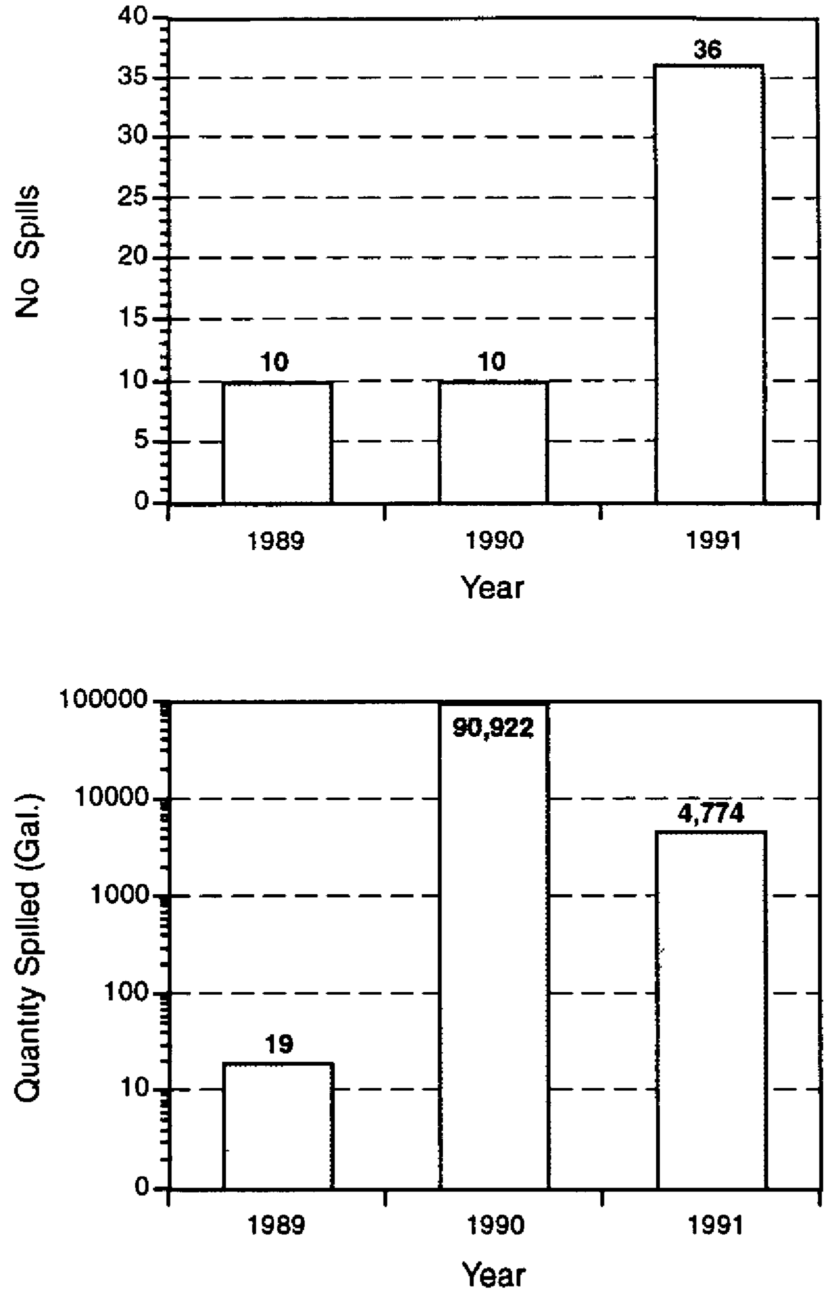
The atmospheric contribution of contaminants from both wet (rainfall) and dry (dust fall/impaction) deposition to aquatic environments is generally poorly known Based upon previous studies in other areas, it is suggested that direct atmospheric deposition to the river will be negligible, and will generally be deposited on land and washed into the river and its tributaries in stormwater runoff Therefore monitoring of tributary loadings and stormwater/CSO runoff should account for most atmospheric deposition.

3.2.5 Accidental Spills

Accidental spills of contaminants to the lower Columbia River and its tributaries represent an additional non-point source of pollution. Oil and petrochemical fuels comprise almost all of the spills reported to the U S Coast Guard Response Center, both in the lower Columbia River and it its tributaries. No clear trends were apparent between the number of spills reported between 1989 and 1991 and the total volumes entering the river (Figure 10). Since most of the reported volumes to the river were small, cumulative annual volumes are largely a function of any major spills that were reported. Of the tributaries studied, the Willamette River accounted for 44, 75, and 71 percent of the total number of tributary spills reported in 1989, 1990, and 1991, respectively Within the lower Columbia River, itself, the two largest spills (90,000 gal and 4,000 gal) reported over the three year period were in Youngs Bay and Astoria, suggesting an area of concern for elevated oil and grease concentrations in sediments

3.3 EVALUATION OF IN-PLACE SOURCES OF POLLUTION

There are 17 hazardous waste and Superfund sites within 1 mile of the lower Columbia River (Table 5). All of these sites fall within only two of the river segments: 2C (the Longview area), and 4A (the Portland/Vancouver area). Contaminants of concern are highly variable depending on the activity or history associated with individual sites (Table 5). Data were insufficient to estimate loading to the river, however, information determined about site



Source U S Coast Guard National Response Center Database.

Figure 10. Total Reported Chemical Spills and Quantities Spilled in the Lower Columbia River, 1989-1991.

TABLE 5 CHEMICALS OF CONCERN AT HAZARDOUS WASTE SITES ADJACENT TO THE LOWER COLUMBIA RIVER
(Page 1 of 2)

River Segment	Facility	City	State	Pollutants of Concern	Media Contaminated
2C	Longview Fibre	Longview	WA	Priority pollutant metals	Groundwater, surface water (P), soil (P), sediment (P)
	Ostrander Rock Disposal	Longview	WA	Priority pollutant metals (S) non-halogenated solvents (S), conventional inorganic contaminants (S)	Groundwater, surface water (P), soil (P)
	Radakovich Landfill	Longview	WA	Other metals, phenolic compounds, dioxin, conventional inorganic contaminants base/neutral compounds, priority pollutant metals (S)	Groundwater, surface water, soil (P)
	Reynolds Metals	Longview	WA	PCBs, conventional organic contaminants, conventional inorganic contaminants	Groundwater, surface water, soil, sediment
	Weyerhaeuser-Longview	Longview	WA	Priority pollutant metals other metals	Groundwater, soil
4A	Allied Plating	Portland	OR	Heavy metals	Groundwater, soil
	Columbia Steel/Joslyn Sludge Pond	Portland	OR	Creosote, PCP, THP	Groundwater, soil
	Malarkey Roofing Co	Portland	OR	Lead, zinc	Soil
	Nu Way Oil Company	Portland	OR	PCBs, VOCs, heavy metals, petroleum hydrocarbons	Groundwater, soil
	East Multnomah County	Troutdale	OR	DCE, PCE, TCA, TCE	Groundwater, surface water, soil
	ALCOA (Vancouver smelter)	Vancouver	WA	Halogenate organic compounds, PCBs, conventional inorganic contaminants, base/neutral organics	Water, sediment
	Burlington Northern	Vancouver	WA	Priority pollutant metals, PCBs, pesticides, petroleum products (S), non-halogenated solvents, PAHs, base/neutral organics	Soil, groundwater (P)
	Columbia Marine Lines	Vancouver	WA	Petroleum products	Groundwater, soil (P)

TABLE 5 CHEMICALS OF CONCERN AT HAZARDOUS WASTE SITES ADJACENT TO THE LOWER COLUMBIA RIVER
(Page 2 of 2)

River Segment	Facility	City	State	Pollutants of Concern	Media Contaminated
4A (cont)	Frontier Hard Chrome	Vancouver	WA	Priority pollutant metals	Groundwater, soil
	Griffey (Custom Care) Cleaners	Vancouver	WA	Halogenated organic compounds, petroleum products, non-halogenated solvents	Soil, groundwater (P), surface water (P)
	Port of Vancouver	Vancouver	WA	Halogenated organic compounds priority pollutant metals, petroleum products (S) conventional organic contaminants (S)	Sediment, groundwater (P)
	Tidewater Barge Lines	Vancouver	WA	Non-halogenated solvents priority pollutant metals (S)	Sediment groundwater (P)

(S) Suspected
(P) Potential

distribution and chemicals of concern provide useful information for evaluating potential impacts to water quality

The 18 landfills within 1 mile of the lower Columbia River are also primarily within river segments 2C (the Longview area) and 4A (the Portland/Vancouver area) Data on chemicals of concern, media affected (e g , groundwater or surface water), and location of these landfills are summarized in Table 6 No quantitative calculations of pollutant loading estimates could be made, based upon existing data.

Other indicators used to identify areas of potential concern from in-place sources of pollution revealed some valuable qualitative information. Data from U S. EPA CERCLIS and RCRA site listings indicate that the counties bordering river segments 2C (the Longview area) and 4A (the Portland/Vancouver area) may have the greatest potential for future hazardous waste contamination, due to the large numbers of sites listed. Studies of septic tank construction and failure permits do not suggest any areas of concern on the lower Columbia River, based upon the sparse housing development along the majority of the river. However, leaks could cause localized problems in those areas with dense, non-sewered development

TABLE 6 CHEMICALS OF CONCERN AT LANDFILLS ADJACENT TO THE LOWER COLUMBIA RIVER
(Page 1 of 2)

River Segment	Facility	City	State	Pollutants of Concern	Media Contaminated
1B	Astoria Landfill	Astoria	OR	Iron, manganese	Groundwater
2A	James River II Industrial Waste Landfill	Wauna	OR	NA	NA
	James River Industrial Landfill	Wauna	OR	NA	NA
	Cathlamet Municipal Dump	Cathlamet	WA	NA	NA
2C	Ostrander Rock Disposal Site	Longview	WA	Priority pollutant metals (S), non-halogenated solvents (S) conventional inorganic contaminants (S)	Groundwater (P), surface water (P), soil (P)
	Coal Creek Disposal Site	Longview	WA	Chromium	NA
	Radakovich (Mt Solo) Landfill	Longview	WA	Metals, phenolic compounds, dioxin, conventional organic contaminants, base/neutral compounds, priority metal pollutants (S)	Groundwater, surface water, soil (P)
	International Paper Woodwaste Landfill	Longview	WA	None	None
	Longview Fibre Landfill	Longview	WA	Priority pollutant metals	Groundwater, surface water (P), soil (P), sediment (P)
	Cowlitz County Municipal Landfill	Longview	WA	Iron, manganese	Groundwater
	Kalama Municipal Landfill	Kalama	WA	NA	Groundwater (P), surface water (P)
	Santosh Landfill	Scappoose	OR	Iron, chlorine, sulfate, ammonia	Groundwater

TABLE 6 CHEMICALS OF CONCERN AT LANDFILLS ADJACENT TO THE LOWER COLUMBIA RIVER
(Page 2 of 2)

River Segment	Facility	City	State	Pollutants of Concern	Media Contaminated
4A	Boise Cascade Limited Purpose Landfill	Vancouver	WA	None	NA
	St Johns Landfill	Portland	OR	Iron, manganese, phosphorus, nitrogen, ammonia, copper, cadmium, zinc, lead	Surface water, groundwater
	City of Vancouver Sludge Ash Landfill	Vancouver	WA	NA	NA
	Reidel Demolition Landfill	Portland	OR	None	None
	James River Corp Inert Waste Landfill	Camas	WA	None	None
4B	Hamilton Island Landfill	North Bonneville	WA	Cadmium, copper, chromium, lead, zinc, benzoic acid, toluene	Surface water, groundwater, soil

NA No data available
(S) Suspected
(P) Potential

4.0 SUMMARY OF DATA GAPS

An attempt was made to inventory and characterize the pollutant sources and pollutant loading to the lower Columbia River below Bonneville Dam Information was identified for point and non-point sources of pollutants including municipal, industrial, and agricultural point source discharges, loading from tributaries and the upper Columbia river, in-place pollutants (hazardous waste sites and landfills), accidental spills, and atmospheric deposition Land uses in the counties that border the Columbia River below Bonneville Dam were also summarized, and the types of pollutants associated with those uses were described However, data gaps prevented an adequate assessment of pollutant loading to the river This section discusses these gaps and recommends general measures for gathering the information needed to quantify and to assess the relative contribution of specific pollutants to the river.

4.1 POINT SOURCES OF POLLUTION

The regulatory permit process for point sources is designed to ensure that pollutant discharges do not result in ambient concentrations that exceed levels that will adversely affect aquatic biota, human health, or beneficial uses of the river. NPDES-permitted discharges are required only to monitor pollutant variables that will most likely cause receiving water criteria to be violated Therefore, some permitted dischargers may monitor fluoride, boron, antimony, and benzo(a)pyrene while other dischargers may monitor only BOD and TSS. However, for the purpose of assessing pollutant discharges to the river, a loading estimate is needed for each pollutant from each point source. For this study, loading data were most complete for wastewater discharge volume, BOD, and TSS. Data were inadequate for assessing the relative contribution of nutrients, metals, and organic compounds from the various point sources

4.2 NON-POINT SOURCES OF POLLUTION

4.2.1 Land Use

Non-point pollutant loading to the river is affected by the land-use activities that occur within the watershed of the Columbia River Basin. A summary of land use by county is presented in Table 7 An investigation of land-use within the entire river basin was not possible in this study, however, land-use data were presented by county and the type of pollutants associated with each land-use classification were identified. Close analysis of the sources and quantities of pollutants entering the lower Columbia River below the Bonneville Dam indicates that much of the non-point source pollution entering the river does so indirectly via large tributaries. Therefore, information on land use within the larger drainage areas would be more relevant than the land-use information on counties bordering the lower river. The land-use information available was also too general for an assessment of the relative proportion of land-use types in the area immediately adjacent to the river

4.2.2 Urban Stormwater and Combined Sewer Overflow Runoff

Potentially important contributors to pollutant loading to the Columbia River are urban and stormwater runoff from residential, commercial, and industrial areas, and combined sewer overflows (CSOs) from municipal wastewater collection systems discharging mixed stormwater and untreated municipal sewage. Runoff from stormwater carries dissolved and particulate pollutants picked up from a wide range of undisturbed and disturbed drainage areas and thus can be considered non-point pollution. These sources are typically routed to discrete outfalls, where they are discharged directly to the Columbia River and its tributaries.

With the passing of the Water Quality Act of 1987, the Clean Water Act was amended to instigate a phased approach to controlling pollutants in stormwater discharges. The amendment [Section 402(p)] also established regulations governing stormwater discharge permit application requirements under the NPDES program. These requirements pertain to stormwater discharges associated with industrial activity and medium-to-large municipal separate stormwater systems

To fill this information gap, a telephone survey of several municipalities and port facilities along the Columbia River was conducted to determine the extent of site-specific data on urban stormwater runoff.

No data were identified on contaminant loading from urban stormwater and CSOs. Some data are expected from the City of Portland and Multnomah County after stormwater NPDES permit applications have been submitted. Other data may become available from industrial and port facilities along the river.

4.2.3 Tributary Pollutant Loading

Tributary loading, including the input of pollutants from the upper Columbia river, includes point, non-point, and in-place pollutants. The limited data available indicates that tributaries may be a significant source of some pollutants, but several difficulties prevented more precise determination of the relative importance of tributary pollutant loading. Although tributary pollutant data were identified, this information was generally incomplete for BOD and organic compounds No data were available on pollutants associated with bedload transport More data were available on metals, nutrients, and TSS, but recent work has cast doubt on the accuracy of the USGS NASQUAN metals data (Windom et al 1991) Reported metals concentrations could be as much as ten times or more too high Data interpretation was further complicated because of inconsistencies between flow monitoring stations and water quality monitoring stations

4.2.4 Atmospheric Pollutant Loading

Studies of the relative contribution of some atmospheric pollutants in other areas of the country indicate that atmospheric sources of some pollutants (e g , mercury, nitrogen, and PCBs) may be important To evaluate the relative importance of atmospheric pollutant deposition to the lower Columbia River, atmospheric deposition data are needed based on samples collected within the drainage area Atmospheric deposition of pollutants is currently measured at only one location in the lower Columbia River basin near the City of Portland. However, these data are limited to concentrations of calcium, magnesium, sodium, potassium, sulfate, chloride, and inorganic nutrients. Presently, the relative contribution of atmospheric pollutants, especially mercury or organic compounds, cannot be assessed. However, because tributaries capture much of the pollutant loading from atmospheric sources, tributary monitoring may account for much of the indirect atmospheric pollutant load to the river

4.2.5 Accidental Spills

Although data on accidental chemical spills is reported to the U.S. Coast Guard and maintained in a centralized database, the U.S Coast Guard cautions against too much confidence in the quantities reported This is primarily because, smaller spills reports are not verified Therefore, information on many of the quantities reported are not subject to any quality control checks for consistency

4.3 IN-PLACE SOURCES OF POLLUTION

Few loading data were available for assessing the potential pollutant loading due to in-place pollutants An estimate is needed of loading due to hazardous waste sites and landfills Although data characterizing the actual contamination of landfills and hazardous wastes were essentially adequate, sparse data were available addressing the soil hydraulic conductivity and groundwater flow rates necessary to calculate loading rates. Since groundwater processes are frequently complex, further area-specific groundwater modeling must be conducted before reasonable estimates of loading rates can be made.

5.0 RECOMMENDATIONS

To reasonably assess the relative importance of each specific source of pollutants to the lower Columbia River, a list of pollutants of concern should be developed Such a list was developed and used in the initial design of a reconnaissance survey of the lower Columbia River which took place in October 1991 This list included most of the pollutant monitoring parameters required in NPDES permits of the direct point source discharges and pollutants identified here for tributary loading (especially the metals identified above), land use, and in-place pollutants. This list also included the trace metals identified above, nutrients, and organic pollutants, including U.S. EPA priority pollutants and commonly used pesticides. It is recommended that this list be updated based on data collected in the reconnaissance survey and as further data or contaminants present in nonpoint sources becomes available.

The following points were considered in the design of the reconnaissance survey.

- Locations of major municipal and industrial point source discharges

- Locations of major tributary discharges, including the input of water from the upper Columbia River Tributaries of concern include the Willamette, Sandy, Kalama, Cowlitz, and Lewis rivers.

- Locations of large urban areas where stormwater and CSO concerns have been identified. These areas include the Portland/Vancouver and Longview areas.

- Locations of concentrated sources of in-place pollutants. These include the Portland/Vancouver and Longview areas.

Sediment sampling areas were located in depositional areas, both upstream and downstream of these concentrated sources of pollutants in order to evaluate the effect of these sources on sediment quality Water quality sampling stations were located in a similar manner. Task 2 results suggest that the discharge of pollutants from tributaries may represent a substantial proportion of the total pollutant loading to the lower Columbia River. Therefore, water quality and sediment quality samples were also collected within the major tributaries and from the upper river reach below the Bonneville Dam in order to make a preliminary assessment of the influence of pollutant loading from these sources

Based on the revised list of pollutants of concern discussed above, a methodology for estimating pollutant loading from each source should be developed for each pollutant Both field sampling and dry lab estimation techniques (including mathematical screening models) should be considered A more accurate and complete estimation of the relative importance of the various sources of pollutants of concern to the lower Columbia River will aid decision-makers, including the public, in allocating resources to planning and implementing strategies to reduce the threat of degradation of the lower Columbia River.

The following are specific recommendations for assessing the relative contribution of pollutants from the sources described above.

5.1 POINT SOURCES OF POLLUTION

Based on a list of pollutants of concern, regular and consistent monitoring of the effluent of the major facilities should be performed Minor facilities should be monitored on a random design stratified by season (wet and dry) Field and laboratory protocols should be consistent and analytical method detection limits appropriate for an accurate determination of pollutant loading from point sources The sampling design should allow for the estimation of the statistical uncertainty of the calculated pollutant loading

5.2 NON-POINT SOURCES OF POLLUTION

5.2.1 Land Use

Because much of the non-point pollution is contributed by tributary confluences (point locations) along the mainstem of the river, the land use of each drainage basin could be targeted for an assessment. Analysis of pollutant sources from tributary basins should first focus on the largest drainage basins, especially those of the Willamette, Cowlitz, and upper Columbia rivers.

The drainage areas along the lower Columbia River, outside of large tributary drainage basins, should be assessed for the potential quantity and quality of runoff from nearshore land-use types Attention should focus on urban and agricultural land uses along the river Based on estimates of pollutant loading from diffuse sources along the river, the significance of these sources and the feasibility of incorporating these data into a numerical model can be determined

5.2.2 Urban Stormwater and Combined Sewer Overflow Runoff

The importance of pollutant loading from these sources should be included in the general assessment of land use along the river recommended in Section 5 3 2

5.2.3 Tributaries

Monitoring of pollutant loading from tributaries will serve to identify those watersheds that are contributing substantially to pollutant loading to the lower Columbia River, and by evaluating trends over time will allow an assessment of whether State efforts to reduce tributary pollutant levels are having the desired result. Ideally, pollutants of concern and river flow should be monitored monthly at locations near the mouths of the major tributaries, yet far enough upstream to avoid tidal influences. The tributaries to be monitored should be identified in order to account for approximately 80 percent or more of the flow to the lower Columbia River below the Bonneville Dam and greater than 80 percent of the pollutant loading. The contribution of pollutants from the upper Columbia River should also be monitored regularly Smaller tributaries should be monitored based on a random design stratified by season (wet and dry) Field and laboratory protocols should be consistent with those recommended for point source monitoring to facilitate comparison of the estimates of loading from point sources and tributaries An assessment of sediment bed load transport of contaminants should also be performed

5.2.4 Atmospheric Pollutant Deposition

To determine whether atmospheric deposition is a significant source of pollutants entering the lower Columbia River, a deposition model similar to the one used to evaluate atmospheric pollutant sources to Commencement Bay (PSWQA 1991) could be used as a screening level model A heavily industrialized and urbanized area of the river (e.g., the Portland/Vancouver area) should be selected for this study to determine worst-case loadings A network of atmospheric deposition stations could also be established to evaluate the mass deposition rate directly to the river and to the drainage basins of the tributaries.

5.2.5 Accidental Spills

Accidental periodic reevaluation of accidental spill data should be conducted from the U S Coast Guard National Response Center Database. Despite potential quality assurance/quality control problems with the database information, data will still provide areas either with the most or largest chemical spills.

5.3 IN-PLACE SOURCES OF POLLUTION

A screening model approach should be used to determine the potential impacts of surface and groundwater transport of in-place pollutants to the lower Columbia River The Portland/Vancouver area could be considered the pilot study area, because it is currently the focus of a large groundwater flow process study and is the location of 16 landfills and hazardous waste sites in the study area

6.0 REFERENCES

Geldreich, E E, and E W Rice 1987. Occurrence, significance, and detection of Klebsiella in water systems J AWWA 79(May) 74-80

Puget Sound Water Quality Authority (PSWQA). 1991. Evaluation of the atmospheric deposition of toxic contaminants to Puget Sound Prepared for U.S. Environmental Protection Agency, Region X, Seattle, WA. 173 pp

Tetra Tech 1992 Reconnaissance survey of the lower Columbia River. Task 2 Data Analysis Report: Inventory and Characterization of Pollutants. Prepared for the lower Columbia River Bi-State Water Quality Program.

Windom, H L, J.T Byrd, R G. Smith, Jr., and F. Huan. 1991. Inadequacy of NASQUAN data for assessing metal trends in the nation's rivers. Environ. Sci. Technol 25:1137-1142